DOCUMENT RESUME

ED 297 949 SE 049 424

TITLE	Educational Module on Conservation and Management of Natural Resources. Environmental Education Series 3. Unesco-UNEP International Environmental Education Programme.
INSTITUTION	United Nations Educational, Scientific, and Cultural Organization, Paris (France). Div. of Science, Technical and Environmental Education.
REPORT NO	ED-83/WS/38
PUB DATE	86
NOTE	92p.
AVAILABLE FROM	Connect, UNESCO, 7 place de Fontenoy, 75700 Paris, France (free while supply lasts).
PUB TYPE	Guides - Classroom Use - Guides (For Teachers) (052) -- Guides - Non-Classroom Use (055)
EDRS PRICE	MF01 Plus Postage. PC Not Available from EDRS.
DESCRIPTORS	*Elementary School Science; Elementary Secondary Education; Energy Conservation; *Energy Education; *Environmental Education; Games; Interviews; *Natural Resources; Research; Science Activities; *Science and Society; *Secondary School Science; Surveys; Water
IDENTIFIERS	*UNESCO

ABSTRACT

Environmental education should lead children, as future citizens, to acquire a more objective view of the way human societies function. It should also encourage an individual to take an active part in the community and to arouse the desire to take a responsible attitude regarding natural resource management. This experimental teaching module offers primary and secondary teachers some concepts on the rational management and use of natural resources to guide them in their teaching of these environmental concerns. The module consists of six thematic sections including: (1) "The Source of Our Wealth"; (2) "The Soil and Its Products"; (3) "Water and the Resources of Aquatic Environments"; (4) "Energy"; (5) "Ores and Metals"; and (6) "Societies and Resources". Each section includes a general introduction, suggestions for educational activities, and assessments. Activities are based on methods that emphasize observation of the local environment, documentary research, games including simulations and role playing, surveys and interviews, and problem solving in the local environments. The accompanying teacher's guide includes goals, objectives, and an annotated bibliography. (CW)

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Unesco-UNEP International Environmental Education Programme

Environmental Education Series **3**

Educational Module on Conservation and Management of Natural Resources

Division of Science, Technical and Environmental Education

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PREFACE

From its inception in 1975, the Unesco-UNEP International Environmental Education Programme (IEEP) has organized research, pilot projects and training courses at national level in more than 40 Member States in the various regions of the world with a view to promoting the development of content, methods and materials for this type of education. The experience gained has resulted in a series of experimental publications aimed at covering, from an educational point of view, contemporary problems of the environment through an interdisciplinary approach to teaching which respects the methodological requirements of the different levels and types of formal education and teacher training in this field.

The scope and diversity of environmental problems today have made it necessary to distinguish several problem areas - such as the use of natural resources, pollution, health and nutrition, urban areas, etc. - while paying due attention to geographical, ecological and economic variations.

In this context, this experimental teaching module on the conservation and management of natural resources describes certain worldwide environmental problems with reference to the particular forms they take, especially in the industrialized countries and in certain countries of South America. Other versions of the module, adapted to the special features of other regions and subregions, are in preparation (the humid tropical zones in Africa, Asia and Latin America and the Caribbean, and the arid and semi-arid zones of the Sahel).

The aim of this experimental teaching module on the conservation and management of natural resources is to offer primary and secondary teachers some vital concepts on the management of natural resources, together with a set of educational activities with an interdisciplinary slant, to guide them in their teaching of these environmental issues.

To make it easier to use, the module has been divided into two parts. Part One sets out the basic components to be used by the teacher in organizing his teaching work (general educational objectives, lists of concepts, educational activities, evaluation procedures). Part Two deals with a series of subjects that are important for a study of the conservation and management of natural resources: the source of our wealth, the soil and its products, water and aquatic environments, energy, ores and metals, and societies and natural resources. Each section in this part contains an introduction to its subject, a series of educational activities for pupils and instruments for evaluating what has been learned.

Lastly, the experimental nature of the module should be stressed. Teachers are invited to make use of the content, methods and examples in a critical spirit, adapting them to local conditions and systematically assessing their educational effectiveness.

The general approach, the teaching methods employed and the particular structure of the module have been devised by the ED/STE/ENV Section. The text itself has been prepared by Professor Christian Souchon of the University of Paris VII, who benefited from the active co-operation of that university's Teaching and Research Unit on discipline-centred teaching methods.

INTRODUCTION

The satisfaction of needs, for both individuals and societies as a whole, depends on various resources from which we are able both to derive a great variety of amenities (buildings, forms of transport, household equipment, etc.) and to satisfy our basic needs for survival, such as food, housing, clothes and health.

In addition to the primary material resources which are directly used for the satisfaction of basic needs or of needs that are now regarded as indispensable in certain industrialized societies, we should not overlook other resources connected, for instance, with the cultural heritage created by civilizations (architecture, works of art, even entire man-landscapes) or with the natural heritage (conservation of animal and plant species, of natural sites and so forth). Stress should also be laid on the interrelationships between the resources employed and their consequences.

For example, minerals cannot be obtained without expending a certain amount of energy, and the more diffusely the resource sought occurs in nature, the greater the amount of energy; similarly, in modern systems of agriculture or stock-raising, production depends partly on an input of energy directly linked to the mechanization of agricultural work or indirectly involved in the manufacture of equipment, nitrogen fertilizers, pesticides, etc., and partly on the use of non-renewable mineral resources (phosphates, potassium, etc.). A resource such as water is not confined to household uses but is also employed in large quantities for the mining and working of metals, for paper-making, in the chemical industry, for irrigating crops and watering cattle, and so forth.

Over the last few years there has been increasingly acute awareness among both officials and the general public of the depletion of certain natural resources, of the wastage engendered by certain lifestyles and of forms of pollution which render a proportion of resources unusable.

Much emphasis has been placed on the unequal consumption of these resources between the various countries - especially energy and food - but the problem also concerns exhaustible mineral resources, wood, water and so on.

In thinking about resources, one cannot overlook the fact that the greatest example of waste in our societies is that caused by the war industry, or rather war itself. Although obvious, this fact is mentioned less often than it should be, possibly because many people still mistakenly regard peace as a blessing beyond their reach.

An environmental education based in part on this theme of resource management should lead the child, and through him the future citizen, to acquire a more objective view of the way human societies in general and his own in particular function. It should also encourage the individual to take a more active part in the life of the community, arouse his desire to take his share of responsibility and make him understand that the first rule in natural resource management is to avoid wastage. Lastly, it should make him realize that the future of mankind and the quality of life of future generations largely depend on the choices he himself will be required to make during his own lifetime.

Part One

TEACHER'S GUIDE

CHAPTER I

GOALS, OBJECTIVES AND CHARACTERISTICS OF ENVIRONMENTAL EDUCATION

Environmental education

Whether one is a member of a social system with a heavy consumption of resources of all kinds or of one seeking to develop the resources necessary to the satisfaction of basic needs, the problems connected with the use of natural resources are so important that they require not only the earliest possible remedial action but also a more long-term effort which must necessarily involve education if it is to have a deep and lasting impact. It is in fact one of the essential responsibilities of education systems to prepare children - future citizens - for the changes which will produce a better world in times to come.

The general goals of environmental education, which was born of an awareness of the increasingly rapid growth of environmental problems, were defined by the Intergovernmental Conference on Environmental Education, held under the auspices of Unesco at Tbilisi (USSR) in 1977. This conference showed that environmental education should, first and foremost, strive to sharpen the awareness and sense of responsibility of citizens with regard to their environment and its emerging problems. Citizens should possess the knowledge, attitudes, motivation, commitment and tools needed to work individually and collectively in order to solve current problems and prevent the emergence of new ones.

To achieve this general goal, it was agreed that environmental education should help individuals:

to understand that man is inseparable from his environment and that whatever harms his environment has indirect consequences for man himself;

to acquire a basic understanding of how environmental problems may be resolved;

to weigh up the individual and collective responsibilities which must be assumed so as to solve problems through mutual co-operation;

to develop tools for analysis, reflection and action so that the damage suffered by the environment may be understood, prevented and repaired the search for specific forms of action or at least a thorough study of preventive, remedial or alternative measures for the solution of environmental problems).

Some characteristics of environmental education

It is broadly agreed that environmental action should be guided by certain principles, with the result that environmental education has certain special characteristics.

(a) An effort must be made where environmental problems are concerned to determine the interrelationships between factors and reveal the chain reactions that occur, so as to arrive at an overall critical analysis.

(b) The teachers of environmental education must also respect certain conditions of interdisciplinarity, since every facet of a particular environmental problem should be examined from a general standpoint, using inputs from traditional sciences as well as more recently introduced disciplines in the human sciences, which allow the psychological aspects (attitudes and motivations) and the sociological, political, economic, historical, moral and aesthetic aspects of an environmental problem to be taken into consideration. The teacher will frequently be called on to act rather as an educator and a citizen than as a specialist in a single discipline.

(c) Priority must be given to studying the environment which actually concerns the child pupil or student, i.e. the individual environment in which he lives, at home in his family, and in the community of which he is a member.

(d) There is also general agreement on the use of active methods, which are necessary to conduct investigations, documentary research and discussions in which opposing views and opinions can be useful for forming value judgments. The active methods employed in environmental education also confer a special role on the teacher, who should see himself as a member of a team, as a guide and adviser helping pupils in their search for documents and information rather than as a source of predetermined knowledge; for reasons of speed and effectiveness, however, he may also be approached as a 'resource' capable of providing information on particular points.

(e) As for teaching objectives relating to affective behaviour, cognition and practical skills, environmental education should make it possible to achieve specific results. Where behaviour is concerned, the main focus will be on developing an awareness of problems so that they will be clearly perceived and sensed by individuals and communities; the aim will be to develop attitudes which take account of social values and commit the pupil to active participation in the protection and improvement of the environment. On the cognitive side, the aim will be to provide pupils with the knowledge to enable them, among other things, to gain access to existing documentation and to grasp the basics of the technical aspects of environmental problems; also to give pupils tools to analyse problems and methods to apply their knowledge. Practical skills will be developed with a view to specific activities connected with the environment.

(f) Environmental education will not fully attain its goal unless the action it stimulates and the activities it suggests spread their influence through the community to which the pupil belongs. In this way its impact will be broadened and applied not only in the school, but also in the home, the village, the community or for example the various associations and groups which the pupil may join.

(g) Lastly, although environmental education should be judged mainly on its long-term effects on the behaviour of the future citizen, it is nevertheless desirable to make the most immediate possible use of what the pupils have learned on the subject by applying their knowledge to practical situations.

Environmental education should therefore:

(1) encourage the use of a comprehensive, systemic and interdisciplinary approach to the environment;

(2) analyse the problems at:

- the individual level,
- the collective level (local, national, regional, or even international), possibly also involving comparisons between various regions or countries;

(3) lay the emphasis on real situations and possible or foreseeable future developments;

(4) use as far as possible the problems of the community to which the pupil belongs, at least as the starting-point for discussions on problems which may arise on a larger scale;

(5) show the relationship between technical knowledge, problem-solving and the influence of established values;

(6) stress both the need for active participation leading to specific action, and a desire and concern to play a real part in the work of planning, developing and managing the environment.

CHAPTER II

PRESENTATION OF THE MODULE

Structure of the module

In furtherance of the general objectives of environmental education, this module is designed to help teachers and pupils:

- to consider objectively the concerns and values which guide or ought to guide rational resource management;
- to take practical action which reflects their new awareness and their desire to have some share in the responsibility for resource management.

The module is particularly aimed at two levels of formal education (roughly speaking, the lower and upper general secondary courses) and takes account of the fact that, as pupils mature, it becomes possible:

- to move on from subjects mainly concerned with perception to ones which leave more room for abstraction;
- to deal more easily with quantitative aspects and more complex interrelationships;
- to extend if necessary the area under study (school - district - town - nation - world);
- to propose remedies or more likely alternatives based on technological data from real situations.

The module is divided into six thematic sections covering the following subjects:

- the source of our wealth;
- the soil and its products;
- water and the resources of aquatic environments;
- energy;
- ores and metals;
- societies and resources.

The first section is intended to present a panorama of the use of resources, in other words to situate man's role as a consumer of them. The next four sections are focused on the study of some of the main types of resources, which have been distinguished by their nature or by their origin. The last section shows how the way in which resources are managed in the different societies gives a basic indication of how each functions in respect of aspects such as the organization of the habitat, the solutions found to environmental problems, attitudes to the different forms of heritage, the history of resource use and so on.

Each of these thematic sections contains:

(a) a fairly general introduction to the theme, which sets the main concepts in a context and provides a few basic facts. If more detail is needed, it should be sought in the works listed in the bibliography or in any other source of documentation. It might be worth producing a series of selected, classified and annotated documents in the form of brochures specially written to this end for teachers.

These introductory texts may be used in two ways: to introduce the theme so as to start off an initial discussion, or to go deeper into the subject after some preliminary activities; in either case, the style of presentation makes some help from the teacher necessary, except where the most self-reliant pupils are concerned.

(b) several activity notes, designed for a particular level (I or II) or suitable for both levels (I and II). The content of these notes should be regarded as no more than a set of suggestions to be adapted to the conditions of each society. Quite considerable adjustments may be necessary if it is desired to take account of the four possible types of social environment, roughly distinguished as follows:

- heavily industrialized society, urban areas;
- heavily industrialized society, rural areas;
- relatively unindustrialized society, urban areas;
- relatively unindustrialized society, rural areas.

(c) one or more means of evaluation (questionnaires, test activities, etc.) to enable the teacher to assess certain aspects of what has been learned or to use as a source of ideas for the development of other means of evaluation geared to his particular classroom situation.

The activity notes always respect the following plan:

- Level (or target group)
- Specific goals and objectives
- Duration of the activity
- Disciplines (or subjects) concerned (i.e. the most appropriate teaching team)
- Equipment required
- Description of the activity
- Exploitation of the activity.

The 'Exploitation' component is designed:

- to facilitate the summing-up of the activity, if only by means of a simple discussion with a view to drawing conclusions; and
- to remind pupils of the importance of relating these conclusions to the outside world (the community concerned by the problem in question). Attention is also drawn to possible follow-up such as further research or practical action.

As the time needed for the activities proposed under this heading varies greatly, no indication has been given.

The suggested educational activities vary from one theme to another and also, within each section, from one subject to another (each section contains about five activity notes); most of them are based on active teaching methods, with the main emphasis on:

(a) Observation of the environment: the observations made by the pupils of their surroundings (at home, in the street, more generally in their local area, etc.) constitute the first kind of information and thought-provoking material to be considered; the pupils will also be guided by questions to encourage greater precision and detail, and

will sometimes be directed to conduct investigations on a particular subject. In many cases such investigations will bring them into contact with people concerned by the problem under study (local inhabitants, officials, industrial operatives, etc.). Their reports on what they have observed and found out must be prepared with great care as their findings will form an important part of the basic information to be used by the group of teachers and learners.

Talking with experts yields information not only on technical and economic problems but also on the constraints taken into account in making choices and on the kind of values which have consciously or unconsciously influenced decisions.

(b) Documentary research: the search for documents takes various forms and serves different purposes. Illustrations (photographs and drawings) cut out from magazines, for example, can be used to build up a set of pictures:

- to back up a discussion
- to make cards for games
- to contribute to the presentation of results,

The texts, and the figures they contain, will not only add to the pupil's knowledge but also suggest topics to think about and direct them to other printed sources for eventual exploration.

Major enterprises, private or semi-public organizations, administrative bodies and ministries often have information materials for the general public, some of which are specially aimed at schoolchildren.

(c) Games: there exist fully developed teaching materials, mainly intended for the training of key personnel, based on the possibility of simulating economic situations, for example in an enterprise; many of them deal with problems of resource management (energy, raw materials, etc.). However, they are too intellectually sophisticated to be mastered by secondary pupils. More simple games, such as those which use cards to be matched in some way or involve advancing counters through squares which represent schematically certain situations or ideas, can be made up beforehand by the teacher or constructed during the activity itself by teacher and pupils together. Certain games of this type which are to be had on sale, could also be employed and examined from the point of view of their objectives and how these are attained.

In this module, role-playing has an important place: certain pupils are each asked to choose a person who, in a given context, would have a particular role in decision-making (e.g. an administrative officer) or in formulating opinion (e.g. an activist in an association). All these characters would take part in a discussion. Role-playing is one way of making pupils aware of values, of the existence of constraints, of how to define objectives and make choices, etc. It can be used to prepare the ground for conducting interviews or attending public debates and it also teaches pupils to be more tolerant towards differing opinions as well as to develop and express reasoned value judgements.

(d) Surveys and interviews: the aim of these could be to analyse the various types of attitude towards a particular problem on the part of the general public (or a particular group of people). However,

the most important thing is to identify the structures, and within them the officials, through which society makes its choices, carries out its decisions and takes the necessary action at the technical or human level. Where information is concerned, contact with experts or technicians will often prove indispensable for a thorough understanding of the constraints. The variety of interviews and the subjecting of the replies compiled to subsequent analysis will ensure a more objective approach and smoother progress towards reasoned and measured judgements. The vital point is that pupils should perceive how the individuals of a community feel at home in, and relate to, their environment.

(e) Practical action: action on the local environment is the best possible adjunct to a teaching approach based on problem-solving and should therefore be given maximum encouragement. Practical activities require preliminary organization and tenacity in carrying them through. There will be a fairly wide selection of activities to choose from, ranging for example from preparing a project for submission to the appropriate authorities to carrying out actual work (collection of waste for recycling, the planting of trees, etc.). It is also worth paying special attention to activities designed to stimulate the awareness of communities, since such activities can lead adults and officials to take action.

For each thematic section instruments have been prepared for evaluating what the pupils have learned. These are presented basically as post-tests, but they could be used, if necessary in simplified form, as pre-tests administered before the actual activities. The proposed evaluations are based on:

- open-ended questionnaires for use on an individual or group basis; the phrasing of certain questions could also serve as titles for written work;
- closed questionnaires of the multiple-choice or true-false type, for individual use;
- a suggested group activity focused on solving a problem. This is an extremely important aspect of evaluation, since in fact any genuine overall evaluation of environmental education should be a long-term exercise in which its effectiveness is judged from the behaviour of citizens.

A few guidelines for using the module

1. With regard to content, the module has been designed for great flexibility in use. Each thematic section is in fact a submodule which can be employed independently of the others. Teacher and pupils may thus choose one or more, or all the sections, arranging the different sequences in the light of their relevance to the curriculum, the amount of time available and the interests of the class.

2. Bearing in mind the age and educational level of the pupils when introducing such activities the teacher may emphasize the following points:

(a) For level I:

- identification of the sources of products and resources, their use, etc.
- perception and brief analysis of the problems
- practical activities not requiring elaborate organization, possibly even going no further than reflecting the will to act.

(b) For level II:

- study of interrelationships and relations of cause and effect
- the repercussions of forms of organization on resource management
- practical activities suitable for effective inclusion in a more comprehensive project
- collection and processing of statistical data.

3. Generally speaking, the overall approach to the problems set in each of the thematic sections could be based on the following stages:

(i) Identification of the problems and description of the facts and processes with their interrelationships.

(ii) Highlighting of the main concepts; inventory of the main basic areas of knowledge.

(iii) Clarification of the accepted values involved in the problems studied. Analysis of behaviour patterns in regard to these values.

(iv) Definition of teaching objectives.

(v) Suggestion of teaching activities. Conduct of practical activities.

(vi) Search for links with the world outside school in order to state the approach and the results obtained.

(vii) Evaluation of the activities and of the teaching approach.

4. Lastly, it should be stressed that this module is experimental. Teachers should adopt a critical attitude to both the content and the methods proposed and adjust them where necessary to local environmental, economic and cultural conditions.

SUMMARY TABLE OF THE MODULE'S CONTENTS

SECTION	ACTIVITY NOTE	LEVEL	EVALUATION
I. The source of our wealth (Chapter IV)	1) Observing a landscape	I & II	- Questions
	2) What do we consume?	I & II	- Multiple choice
	3) Our food	I & II	- Group evaluation
	4) Our needs apart from food	II	
II. The soil and its products (Chapter V)	1) The soil and erosion	I & II	- Questions
	2) The life of the forest	I	- Multiple choice
	3) The forest and its products	I	- Group evaluation
	4) Agricultural resources from crops	I & II	
	5) Stock-raising and animal products	I & II	
III. Water and the resources of aquatic environments (Chapter VI)	1) Water in everyday life	I	- Questions
	2) The use of water in the home	II	- Multiple choice
	3) Water and agriculture	I & II	- True/false
	4) Water in nature	I	- Group evaluation
	5) The resources of aquatic environments	I & II	
IV. Energy (Chapter VII)	1) Energy in the home	I & II	- Questions
	2) Energy outside the home	I	- Multiple choice
	3) Transport	I & II	- True/false
	4) History of oil up to the present time	I & II	
	5) Nuclear energy: hopes and fears	II	
	6) New forms of energy	II	
V. Ores and metals (Chapter VIII)	1) The metals in our lives	I	- Questions
	2) The wasteful use of metals (games)	I	- Multiple choice - Group evaluation
	3) Where are metals found?	I	
	4) The consumption of metals	I	
VI. Societies and resources (Chapter IX)	1) History, civilizations and resource management	I & II	- Questions
	2) Attitudes towards the consumption of resources	I & II	- Multiple choice
	3) The habitat	I & II	- Group evaluation
	4) Waste matter: an unexpected resource	I & II	
	5) Nature: a resource to be protected	I & II	

CHAPTER III

ANNOTATED BIBLIOGRAPHY

. Use and Conservation of the Biosphere, Unesco, 1970, 272 pp.

This volume is based on the proceedings of the Intergovernmental Conference on the Scientific Basis for Rational Use and Conservation of the Resources of the Biosphere, held in Paris in September 1968. It is a key work for a general view of man's impact on the possible uses, management, risks of deterioration and destruction, and conservation of nature's resources. Each chapter forms a synopsis of the subject treated:

- Contemporary scientific concepts relating to the biosphere;
- Impact of man on the biosphere;
- Soils and the maintenance of their fertility as factors affecting the choice of use of land;
- Water resources problems: present and future requirements for life;
- Scientific basis for the conservation of non-oceanic living aquatic resources;
- Natural vegetation and its management for rational land use;
- Animal ecology, animal husbandry and effective wildlife management;
- Preservation of natural areas and ecosystems; protection of rare and endangered species;
- Problems of the deterioration of the environment;
- Man and his ecosystems; the aim of achieving a dynamic balance with the environment, satisfying physical, economic, social and spiritual needs.

. DUVIGNEAUD, P. - La Synthèse écologique. Doin, Paris, 1980, 380 pp.

A major work which approaches ecology through the study of systems. The author not only shows that he is an experienced specialist but also constantly relates advances in ecology to the search for solutions to the problems of impacts on the environment and resource management.

. EHRLICH, P. and A. - Ecoscience: Population, Resources, Environment. San Francisco, W.H. Freeman and Company, 1977, pp.

This book, which is by no means recent (the first American edition dates back to 1970), sets out the problem of world population growth with respect to the use of resources. The various types of pollution are also covered in a highly instructive manner.

. CERON, J.P. and BAILLON, J. - La Société de l'éphémère. Presses Universitaires de Grenoble, 1979, 254 pp.

Fully documented, with numerous supporting statistics, aptly demonstrates - especially for motor cars but also for household equipment and the building industry - that mineral resources should be used more efficiently by manufacturing goods that last longer or can be recycled more easily.

. SASSON, A. - Developpement et environnement. Mouton, Paris and The Hague, 1974, 423 pp.

Outstanding work which describes, for both non-industrialized and industrialized countries, the problems of population, health, use of natural resources (especially water and energy), and pollution.

. KLATZMANN, J. Nourrir dix milliards d'hommes. PUF, Paris, 1975, 267 pp.

Starting from an examination of the food situation, the author looks at the possibilities for agriculture to solve the problem of hunger in the world. The availability of agricultural resources is seen to be closely linked to technical problems and therefore also dependent on the consumption of metals (mechanization) and energy (fertilizers).

. L'Avenir économique du monde. Pour la Science (the French edition of Scientific American), 37, November 1980, 173 pp.

This special issue of Pour la Science is mainly devoted to two series of articles:

- one on the world-wide use of resources, showing the considerable differences between the industrialized regions and the developing countries (food resources, water, energy, etc.),
- the other on the economic development of various countries (India, Tanzania, China, Mexico, etc.).

. La planète des hommes. Science et Vie, 131, Special Issue, June 1980, 162 pp.

This special issue contains a fully-documented article by C. GUILLEMIN on 'Les reserves s'epuisent mais tout se remplace' (The reserves are running out but there are always substitutes) (pp. 90-103), which sums up the situation regarding available mineral resources and also shows that the energy required to mine them increases with the poverty and scarcity of the ores. See also the article by C. SOTNIKOFF on 'Les Déserts en Marche' (The advancing deserts) (pp. 122-129).

. Dictionnaire de l'Energie. SCM Centre Buret, Paris-La Defence, 1979, 245 pp.

Very complete documentation on energy; the first part contains, in dictionary form with a large number of headings, definitions, explanations of concepts and descriptions of technical processes, etc., together with an atlas showing the zones of production for energy resources and statistical tables.

. Energie. Science et Vie, 126, Special Issue, March 1979, 162 pp.

The entire issue is devoted to energy and concentrates on the problems of energy supplies for France and future prospects for new forms of energy. It ends with a list of works available from the publisher which constitutes a useful bibliographical guide.

.Energy, Time-Life Series, 1963.

With a great many illustrations, explains energy concepts frequently in a highly instructive way and stresses historical and current technologies. There is little, however, on the economic problems of energy.

. COLLI, J.C. Les Energies nouvelles. Fayard, Paris, 1979, 287 pp.

A book for the general public written by the French "Délégué aux Energies nouvelles" between 1975 and 1978. It sums up the situation well, but the lack of a bibliography makes it difficult to continue further documentary research.

. SAMUEL, P. Le Nucléaire en questions, Entente, Paris, 1975, 127 pp.

A work that is critical of nuclear power. Could be usefully supplemented by the information given in Nos. 48 and 49 of Aménagement et Nature (see below).

. SKROTSKY, N. La Nature n'en peut plus. Bulletin d'information du Ministère de l'Agriculture, Paris, 1970, 93 pp.

With many illustrations, this is an excellent work for the general public; though a little out of date, it contains very useful lead-ins to thought and discussion in preparation for going deeper into specific environmental problems.

. FISCHESSER, B. La vie de la forêt. Horizons de France, Paris, 1970, 271 pp.

A beautiful book about the regional forests in France, well documented, fully illustrated and clearly written but unfortunately expensive. See also on this subject Connaissance de la forêt by HUCHON, H., La Maison Rustique, Paris; and the brochures and leaflets produced by the Office National des Forêts.

. ECKHOLM, E.P. La Terre sans Arbres. Robert Laffont, Paris, 1976, 330 pp.

Focused on the problem of the destruction of soils, with deforestation given as the main cause; the consequences for agriculture and food production. Fully documented but easy to read. Copious bibliography covering all parts of the world.

. La Science du paysage. Science et Avenir. 16, rue de la Baume, 75008, Paris, 1974.

Special issue containing articles which provide basic information on a wide range of subjects :

- planning for the natural environment
- the mirror of a society
- safeguarding rural diversity
- the precarious equilibrium of mountains
- what are forests for?
- architecture imitates nature.

. Aménagement et Nature. Quarterly review, 21 rue du Conseiller Collignon, 75016-Paris.

Each issue is devoted to a particular theme. Many interesting titles already published, useful for reference (e.g., among the more recent numbers, Nos.41 to 43 ('Ecotechniques et habitat'), 45 and 46 ('Environnement et éducation') and 48 and 49 ('Energie Nucléaire et Environnement', I and II).

. The Unesco Courrier, Paris. Write to UNESCO PUB/C, Office 1086, 7 Place de Fontenoy, 75700 Paris.

Each issue is devoted to a particular theme. Many of them are relevant to the present module. For example:

- Earth's living resources: a world strategy for action now
- Highlands and islands: ecosystems in danger
- Science and technology: the development dilemma
- Energy for tomorrow's world
- The search for a New World Economic Order.

. Textes et documents pour la classe. CNDP, 29 rue d'Ulm, 75230 Paris Cedex 05.

Educational kits based on photographs, excerpts from texts and statistical data, with statements of aims, suggestions for activities, documentation and ideas for further study. Many of the 250 titles so far published could be used for environmental education.

. 'Le Monde' Dossiers et Documents. 5 rue des Italiens, 75009 Paris.

Mainly composed of press cuttings taken from previous issues of the newspaper 'Le Monde', several of these files deal with the problems of resources from an economic point of view, and may prove useful for level II.

Part Two

TEACHING MODULE

CHAPTER IV

THE SOURCE OF OUR WEALTH

The source of the things we use to satisfy our needs (food, clothing, etc.) or our tastes (leisure activities, travel, etc.) is not always obvious especially as regards the primary resources needed and the sometimes very long series of transformations required to produce these objects. The members of a rural society growing almost all their own food, and therefore without many contacts with the outside, draw most of their resources directly from the land they cultivate. In strong contrast, a city child in an industrialized country thinks that everything comes from the supermarket or department store; in most cases he is completely unaware of:

the existence of mines, factories, fields, grazing-land and the animals that graze on it;

the need for energy and raw materials to make the products and goods he uses or consumes;

the role played by the labour of certain people involved in actual production processes (in his city he often sees only the final use of certain materials, as in the construction of buildings).

To tackle the problem of the management and use of natural resources it is important to begin by identifying these resources.

Types of resources

Every product or object is the end result of

(1) work by people - even if at certain stages in a highly mechanized manufacturing process there is very little of this (but someone has to build sophisticated machines, and service and repair them);

(2) mineral raw materials quarried or extracted from the earth (iron, other metals, certain fertilizers, building stone, etc.);

(3) energy from a variety of sources (organic, for example fossil fuels, now mined like metals; climatic, for example the water in reservoirs to produce electricity; biological, such as firewood).

The use of land for cultivation and forestry, which also involves these three inputs (labour, raw materials and energy) results in products, such as food, natural fibres and wood which are also regarded as resources. Natural environments, or environments only slightly modified by man through hunting, fishing or even gathering, likewise produce resources, above all food.

Water is at once a resource that is indispensable for various purposes (for drinking, farming and industry) and of immense value in itself for the living environments whose development it makes possible. Land for farming, and space for every kind of activity, are precious assets which must be used rationally. Other resources may appear less obvious, such as the natural diversity of animal and plant species and the genetic heritage they represent. To these should be added man-made creations, the achievements of culture, technology or art, all of which are assets difficult to evaluate, especially

in terms of money. Similarly, if we regard man as the manager and user of the environment, he himself becomes a resource through his own capacity for work and getting things done.

How resources are used

To describe the ways in which resources are exploited, processed and used is one way of studying human activity from a fundamentally economic viewpoint without having to bring in the question of money, which is merely a reflection of that activity. It is an approach that is both simpler and closer to actual reality, and a necessary preliminary to any analysis of resource management or any argument in favour of measures to economize or conserve these resources.

An examination of the chain of processes stretching from the first operation to obtain the raw material up to the finished object, its utilization, destruction or recycling, shows that every stage requires energy and machines or tools whose production also requires materials and energy.

It is easy to grasp this by studying a particular chain of processes, from the mining of the raw materials, through their transport (which requires vehicles and roads), their processing in factories (which have had to be built), to the transport of the end product (say a domestic appliance), its working life, its disposal and possible recycling.

This approach also makes it easy to see the exchanges between countries and regions, to note a country depends on others for its supplies of raw materials or energy, to get to know the processes through which it procures these resources and the consequences for the country which provides them, and to appreciate the importance of transport.

The analysis of the ways in which the various countries obtain, employ and manage resources brings out clearly one of the essential foundations of contemporary economic systems. Very few of the heavily industrialized countries in fact are or could be self-sufficient; they use resources from other countries, some of which are very poor. Among the non-industrialized countries, moreover, the situation varies greatly according to whether or not their land is rich in raw materials and/or energy. In this connection account should also be taken of the role of modern technologies, to which the industrialized countries alone have easy access.

ACTIVITY NOTES

1. OBSERVING A LANDSCAPE

Level: I and II

Goals and objectives

Through the careful observation of a landscape, identify a number of human activities:

1. Find in the landscape the signs of human activities (traffic, movement);

2. Identify the various elements of the landscape;

3. State their function;

4. Think over what is needed for these activities;

5. Indicate the result of these activities.

Duration

Half a day on a site; 2 or 3 periods in the classroom.

Disciplines

Geography, economics, biology-agronomy, architecture.

Equipment

For taking notes;

field-glasses, camera;

maps;

pictures and illustrations, to be found;

Activities

1. Choose somewhere high up giving a panoramic view, if possible near where town and country meet (high building, hilltop, etc.).

2. From this point, look at the landscape. Is it a mountainous or flat landscape? Is it wooded, cultivated, with many streams? Are there houses, large buildings, factories? Is it possible to distinguish urban areas, recreation areas, shopping districts, industrial zones, schools?

3. Can you see people moving about, cars, lorries, trains, draft animals, horses, ponies, pets?

4. Are there roads, railway lines, power lines, etc.?

5. Can you see quarries, gravel pits, slag-heaps, etc.?

6. Select certain points, locate them accurately and mark their position on a map (if you have one) or on a simple sketch-map you make yourself. Use special signs to mark objects which have struck you; use colour washers to show up the different uses of space (fields, woods, housing, industrial zones); use different colours to draw in rivers, roads, etc.

7. Look in magazines for pictures or drawings similar to or not unlike the things you have seen. Arrange on a large board the illustrations you find beautiful, useful, interesting or valuable. On another board, arrange those you find useless, ugly, of no value, which you would like to see disappear from the landscape.

8. Draw the landscape you would like to see instead of the one you have observed. You could also imagine and draw the landscape which would exist man had never had, or ceased to have any activity there.

9. Look for other illustrations concerning different countries and other landscapes which you find beautiful or ugly. How do the people in those countries live?

Exploitation

(1) Of all the things man needs, what can be obtained from the locality you have observed?

(2) What had to be used to obtain that result?

(3) What was the original landscape like before it was transformed?

(4) In addition to his own labour, what has man used to develop, build and create the things which make up the present landscape?

(5) Does the landscape contain signs of human action harmful to the environment? Discuss the need either to keep or to remove elements which some people might consider useless or ugly (a building, for example).

2. WHAT DO WE CONSUME?

Level: I and II

Goals and objectives

Find the original source of what we use or consume.

Identify the resources necessary to satisfy our needs or tastes.

Duration

Three or four 2-hour periods.

Disciplines

Geography, economics.

Equipment

As for normal classwork.

Activities

1. Working either individually from a prepared questionnaire or directly during a class discussion in small groups, make a list of the uses to which we put things. For example, make a list of verbs like 'eat', 'wear' or 'travel'.

2. To carry out each of the activities represented by these verbs, what must we obtain?

3. The objects or articles we use:

   (a) are obtained from what products?

   (b) where do these products come from?

(c) have they been processed?

(d) what are the conditions needed to process them?

4. Find or draw a picture large enough to convey an idea of a good number of objects or products that we use. Place this picture on one half of a panel or blackboard; on the other half, using arrows for example, show how particular objects or products correspond with columns containing:

   (a) the verb or verbs which designate the use made of them;

   (b) indications of where they come from (e.g. a cotton jacket is used to be worn); to make it, the raw material is cotton (where does cotton come from?)

   (c) Find pictures which show the raw material used or the manufacturing process.

5. In the same way write down, for a few products or objects, the raw material concerned and where it comes from. What is the initial resource used?

6. Give examples of resources we use, with adjectives you have heard used to describe them. Can the resource you are dealing with be placed in one of the following major categories:

   food resources;

   energy resources;

   mineral resources?

7. Using what you know about life in another country (from reading, television, discussions with teachers or travellers, or from pen-friends in that country, etc.), describe the main objects or products consumed there and then compare them with your own country.

Exploitation

Try to answer the following questions for certain specific objects or products:

(1) What does man need?

(2) What does he do to obtain it?

(3) Even if what we use is in a particular form, what was the product needed to make it in the first place?

(4) What takes place during the 'chain of processes' which links this initial product (raw material) to what we use or consume?

3. OUR FOOD

Level: I and II

Goals and objectives

Note that it is a fact that all human beings have practically the same needs with respect to food, but that they meet these in different ways in different countries;

Think about the way our food is produced;

Find out where it is produced;

Bring out the necessary links between producers in agricultural areas and consumers living in towns;

Demonstrate the forms of transport and processing which are links in the chain between production and consumption;

Make pupils realize that even the food resources required to satisfy vital needs are not equally distributed geographically (localities, countries, regions).

Duration : 2 to 3 two-hour sessions.

Disciplines : Geography, economics, biology.

Equipment

Prepared sets of cards;

equipment as for normal classwork;

map of the world.

Activities

1. Each group of a few pupils draws a card describing the staple diet of a particular population group (see, for example, the Time-Life series on 'What people eat', or do some documentary research);

   (a) locate on the map of the world the place where the population concerned lives;

   (b) consider their diet, classifying what they eat in the three broad categories: sugar, flour, starch - fat - meat, milk, eggs;

   (c) compare with one of your own average meals;

   (d) where does the food eaten by the population come from? Is it obtained locally (fishing, cultivation) or is it imported?

   (e) is the food processed from some basic products?

   (f) answer the same questions for what we ourselves eat.

2. Is one type of meal comparable with, or replaceable by another which is equivalent, or are they very different?

3. Place on the maps of your country and the world signs or symbols for each of our most common foods to show where they are produced.

4. Divide the food you eat into what is essential for physical survival and what is extra. Are the transformations undergone by the food before it reaches you really necessary? Examine a few particular cases.

5. Look in magazines or newspapers for articles on hunger throughout the world. What are the regions which suffer from undernourishment? From malnutrition? What are the countries in which people have diseases caused by eating too much or too rich foods?

Exploitation

(1) Look for advertisements for food products (posters, in newspapers, etc.). Do they influence your eating habits? In what way?

(2) Draw up balanced menus using easily obtainable foods which have been processed as little as possible. Deduce the amount of food that is really necessary. Compare with what people actually eat.

(3) Hunger throughout the world. Exploit the documentation that has been collected in order to emphasize the main aspects of this problem (discussion). Have there been or are there at present any anti-hunger campaigns in your district, town or country? Design exhibition panels on this theme conveying your proposals or those of certain bodies for action.

4. OUR NEEDS APART FROM FOOD

Level: II

Goals and objectives

Bring out the wide variety of resources used in addition to food;

Tackle the quantitative aspects, using specific cases to demonstrate that each individual is represented in overall consumption statistics;

Stress the complexity of the connecting links between basic resources and the manufactured object.

Duration: 2 or 3 work sessions.

Disciplines: Geography, economics, physical sciences.

Equipment: as for normal classwork, plus general documentation such as dictionaries and encyclopaedias.

Activities

1. Make out a list of the objects your family owns and uses, noting in particular the ones which are the most essential and which take up the most room.

2. List the materials used to build your house or flat.

3. For each of these objects or materials, ask yourself:

   what is it made of?

   where do the products used to make it come from?

   what did its production involve?

   does something else have to be done or used to make it work?

4. Using this information, draw up a list of the resources apart from food that a person living in your society needs for his family dwelling, and of the objects he uses regularly.

5. Distinguish between:

   mineral products (iron and iron derivatives, copper, lead; building materials such as stone, cement, tiles, etc.);

   sources of energy (electricity, gas, petrol, etc.);

   products from the land (natural fibres for clothes, wood, etc.)

   products of the chemical industry;

   water.

6. Make out a table showing for each category (in columns, starting from the left):

   the basic resources;

   the raw materials obtained;

   the objects or substances produced.

7. Think about how you could estimate your annual consumption of each of these resources. For example, if your family (4 persons) possesses a car which contains 1000 kg of iron and has a life of 10 years, the consumption of iron per person per year, where the car is concerned, can be put at 25 kg.

8. Compare your own approximate figures (a rough assessment) with the available statistics (your country's annual consumption of iron/number of inhabitants). Discuss any differences you find. Remember that in addition to a car, you use trains, roads, bridges, etc. Look for other forms of community use which are indirectly related to your own individual consumption.

Exploitation

(1) Give a clear account of the difficulties you have encountered in this exercise, and devise a way of presenting your consumption of resources in the clearest possible diagramatic form.

(2) Look for documents, such as diagrams and statistical tables, which will help you to continue your quantitative study of the consumption of resources.

EVALUATION

Questions

1. State what is necessary:

   (a) for building a house;

   (b) for manufacturing a car;

   (c) for obtaining wheat.

2. Do you know any raw materials which burn? Indicate their uses.

3. What raw materials are used to make clothes?

4. Describe and contrast a rural landscape with an industrial one.

5. What happens between the time a field of corn is harvested and the time you eat a piece of bread?

6. Make a list of the main resources necessary for:

   (a) your food needs;

   (b) your energy requirements;

   (c) the manufacture of objects;

   (d) transportation.

Multiple choice

1. Petroleum, plant fibres, the output of silkworms and the hair or hide of certain animals are all used as raw materials:

   (a) in food;

   (b) in the production of energy;

   (c) to make clothes;

   (d) in none of the above.

2. Water is useful because it is:

   (a) a source of energy;

   (b) needed for our leisure pursuits;

   (c) the habitat of various plants and animals;

   (d) an indispensable part of what we eat;

(e) absolutely essential to agriculture for the production of food;

(f) used in great quantities in industry;

(g) none of the above;

(h) all of the above.

3. ... cannot be used as a source of energy:

(a) iron; (b) water; (c) the wind; (d) the sun; (e) wood; (f) petroleum.

4. ... is a vital human need:

(a) television; (b) a car; (c) food; (d) the cinema; (e) mobility; (f) leisure; (g) war.

Group evaluation based on activities

Consider an imaginary but not totally unlikely change in the activities of the area you live in (e.g. industrialization of further industrialization; transition from a mixed farming system of crops and livestock to a system of polyculture or monoculture - or the reverse.

Draw up a plan to forecast changes in energy needs, in the supply of raw materials, in transport and building, etc.

Quantify estimated new needs or savings, and prospect for as yet unused raw materials, etc.

Write a report, as if by a committee set up to study the question, addressed to the local official body.

CHAPTER V

THE SOIL AND ITS PRODUCTS

Societies have always had to rely on the products of the land for their biological survival. The first human beings lived by hunting and gathering in environments that were hardly affected by their presence; later, as animals became domesticated, they used land to pasture their herds. Later still they cleared forests to make way for agriculture in the course of time thus substantially modifying the environment. Today even the most industrialized countries obtain their food resources from the land. Pasture or arable land is farmed by industrial methods to provide us above all with food but also with industrial products such as textiles or tobacco. Moreover, the amount of land available to grow these products, i.e. the soil, is itself now seen to be a limited resource to be employed judiciously and carefully protected. The soils on which forests grow supply us with wood, which has a great many uses.

The soil: erosion and conservation

Soil takes the form of a thin layer (usually averaging a few tens of centimetres thick) lying on top of a geological base (rock), from which it is created through the action of the climate and living beings. Its formation from the elements beneath it takes an extremely long time: for a naked rock to develop into soil 30 cm thick, it takes at least several hundred and even thousands of years. The soil, therefore, cannot be regarded as a renewable resource; on the contrary, it can be irreversibly destroyed. That is why the problems of soil conservation and the fight against erosion are so important. In addition, the soils that are easy to cultivate amount to only about 10 per cent of the land surface of the globe, the remainder being either in regions with too dry a climate or subject to almost permanent frost, or covered by infertile soils (lack of mineral nutrients, difficult to work, etc.).

The soil is threatened by two dangers: loss of fertility and, even worse, the disappearance of the soil itself due to erosion both of which can affect the same area, one after the other. In most cases loss of fertility is a consequence of a reduction in the soil's mineral content (the major elements N, P and K and various trace elements) caused by over-intensive use: the crops carry off or 'export' the mineral elements, which are not returned or restored to the land being cultivated. This may also lead to changes in the soil structure which encourage erosion.

Erosion is caused by wind or running water. The loss of soil particles carried away by water is greatest at times of prolonged violent rainfall and on sloping land; the building of terraces or contour ploughing are two of the techniques which prevent it. The destruction or deterioration of the plant cover by deforestation, clearance and overgrazing with trampling are other main causes of erosion. In tropical countries, deforestation is followed by the formation of laterite: the mineral elements are leached out and a hard sterile crust is formed (laterite).

Losses through erosion are immense: throughout the world several thousands million tons of soil are carried away each year. In addition, an estimated 3000 km2 of good agricultural land disappears each year in the industrialized countries as a result of urbanization and its consequences.

An increasing number of countries have grasped the importance of the fight against erosion and taking effective measures, such as planting windbreaks and reforesting areas which have a heavy runoff.

The forest and its products

Before man exerted his influence the forests represented in most regions (except above a certain mountain altitude and in very cold or very dry regions) the mature stage of the natural vegetation. Today there are still remnants of these primeval forests, almost all of them marked by the action of man. Silviculture, i.e. the growing and tending of trees, is a science in the same way as agriculture.

Where national forests are protected, or at least managed wisely, the action of man is very discreet. For example, in the type of management known as the selection system, the forester tries to make sure tht there are always plenty of seedlings (natural regeneration) and enough young trees to replace mature ones as they are felled; the forest cover always remains extensive, and the soil finds it easy to replenish the minerals exported with the timber from the geological substratum. Artificial regeneration or clear felling techniques are much more similar to farming practices, and the risks of disequilibrium are greater.

The forest is managed by foresters for the production of wood, which has a great many uses. A distinction is drawn between timber (for roofbeams, carpentry, furniture, etc.), industrial wood (for paper or products derived from wood such as plywood and fibreboard, etc.), and firewood for heating or cooking. But the forest also yields other products that are gathered (mushrooms, berries, etc.), sometimes in economically significant quantities, and serves other purposes besides production such as recreation and health-giving contact with nature for the city-dweller. Most foresters usually carry out their work bearing in mind this variety of uses and the need to conserve the forestry heritage.

Crops

Types of crops vary from region to region, according on the one hand to the species grown, which must be adaptable to the type of climate and soil, and on the other to the techniques used and the organization of agricultural land.

Initially, most crops were food crops and the produce was consumed on the spot or by the local population. In many countries with a 'modern agriculture', the cultivation of these crops has become highly mechanized along industrial lines, terminating with a system of distribution and even of processing (the food industries). Industrial cultivation of this type is the rule for exported farm products which yield the farmer a monetary income (cash crops) on his entry into the world of commerce: they may be food products (cocoa, coffee, groundnuts, etc.) or non-food products (natural fibres, tobacco, energy crops, etc.).

Mechanization cuts down work in the fields, but on the other hand requires investment in raw materials (metals), energy (manufacture of equipment; fertilizers and weed-killers) and fuel to operate machines such as tractors. It is through such modern techniques that agriculture has considerably increased its yields.

Stock-raising

In its primitive form, stock-raising was based on the use as pasture of open land in the natural state, with grazing areas of varying size. This way of utilizing the environment was often associated with a nomadic way of life. At the other extreme, the modern form of intensive husbandry (in batteries), with separate harvesting of the plant products used to feed cattle and the preparation of artificial feeds containing a proportion of animal products (milk, fishmeal, etc.), constitutes a very different system which is extremely costly in energy. Moreover, the overall efficiency of this stock-raising system as a supplier of energy to the human body is very low. The same agricultural surface yields 10 to 20 times more food when cultivated than when used for grazing; the amount of food it produces via livestock is one-tenth or less of its yield directly from crops. Most of the proteins obtained from milk, meat and eggs can be obtained directly from crops, and when we compare the amount of protein produced per hectare per year by a stock-raising system with, for example, a crop of legumes, the protein yield of the latter is very much higher.

A lot of thought is now being given to this question, but other factors must also be taken into consideration, such as the present eating habits of the populations concerned. At the same time, much is being done by countries of international organizations to combat effectively the tragic problem of hunger throughout the world, not only through foreign aid but also by attempting to adapt local food production systems.

ACTIVITY NOTES

1. SOIL AND EROSION

Level: I and II

Goals and objectives

Once the project has been completed the pupil should be able to:

recognize the signs of erosion on the site;

identify the type of erosion;

describe the remedial measures taken by the community;

identify the international bodies, governmental agencies, individuals or committees responsible for taking action against erosion;

describe the future projects for improving the zones already damaged by erosion;

work out a plan of action to inform the local community about erosion.

Duration: from a few sessions to several weeks, depending on how much contact can be established with officials and on the investigations in the field.

Equipment:

For taking notes, drawing sketches, making posters and taking photographs;

maps of the region, and old ones if possible;

basins and watering cans.

Disciplines: Geography, ecology, agronomy, economics.

Activities

1. Make a list of the various possible causes of erosion so that the zones of soil erosion may then be more easily identified; include in particular the following cases:

   (a) forest clearance;

   (b) overgrazing;

   (c) mining;

   (d) earth-moving activities;

   (e) road-building;

   (f) crops inadequately covering the soil.

2. Choose a stretch of country near your school and, using your list, look for areas of bare soil or trails of sand or earth after a storm and so find the zones affected by erosion. Locate these spots on the map of the region.

3. Consult farmers, agronomists, park wardens, etc., to ask them about the amount of erosion in the area and their opinion as to the causes.

4. From your reading, thinking about the problem or speaking to people concerned or who have knowledge of it:

   make a list of measures that would prevent or remedy erosion;

   find a number of spots which show signs of strong resistance to erosion or which have been treated with anti-erosion measures.

5. If possible, visit some of these places.

6. Examine the history of your region to see if at certain periods the type of land use has led to soil erosion or deterioration.

7. Fill basins or small boxes with various types of soil and tilt them at different angles so as to form steep and gentle slopes; sow grass or other plants in some of them leaving the others bare; water them and collect the water which runs off at the bottom of the slopes; note its colour and calculate the amount of soil carried away by weighing what is left after it has dried.

8. Look for landscape photographs taken in different countries on problems of erosion. Then, backing these up with selected texts, try to show the worldwide extent of soil erosion and its consequences for agriculture and food supplies; study some of the measures being taken.

Exploitation

1. Present your results in the form of an exhibition and arrange for people from outside the school to see it.

2. In your local area, look for a piece of land that is threatened by erosion but potentially useful if kept in good condition; after consulting people skilled in these matters, propose appropriate solutions (sowing grass, planting trees, adjusting the slope, devising a drainage system for runoff, etc.); organize an activity in which you will work on the piece of land in question. Do this work yourselves or in co-operation with other specialist teams.

2. THE LIFE OF THE FOREST

Level: I

Goals and objectives

On completion of the activities, the pupil should be able to:

describe the variety of trees in a forest;

identify the main plants growing under the trees;

recognize the signs of animal and human activity in the forest;

understand the principal functions of the forest and its utility.

Duration: 1 day on a site; 3 or 4 sessions.

Discipline: Biology

Equipment:

For collecting samples on the spot (knives, boxes, jars, etc.);

drawing materials (or photographic equipment).

Activities

1. Arrange a walk in the nearest forest to your area. Imagine that this forest is unknown territory which you are exploring and that you have to make a report on your mission to decribe what it is like and what goes on inside it.

2. Make sketches of the trees, showing their height, thickness and spacing. What species of trees are present? Are there any comments to be made on their shape? Are there any signs of human activity, of woodcutters, etc.?

3. Under the trees, note the presence of bushes, herbaceous plants and mosses. Try to name the species which take up 'the most room' (the most common or dominant) in this undergrowth.

4. One or two teams could try to spot animals or at least find traces of their activity on the plants or the ground (e.g. nibbled leaves, open seed pods, footprints).

5. Bring back photos, drawings and samples (leaves, twigs).

6. All working together, produce a large drawing, or several separate ones, mainly with the materials you have gathered, in order to show what life in the forest is like.

7. Contact a forester and ask him about his work and how man uses the forest.

8. Hold a class discussion on the following topics: when one or a number of trees are cut down in a forest, does the forest survive? If the whole forest is cut down, is it always possible to make it grow again?

Exploitation

1. At school, examine the samples of plants and animal life that have been gathered and all the materials, sketches and photographs.

2. Describe in writing the purpose of the forest.

3. Then look in books for passages about forests and ask yourself if you have thought about all its functions.

4. Try to find out, for the great forests in different parts of the world:

   (a) the principal types of tree they contain;

   (b) the uses of the wood they produce;

   (c) whether the wood is employed locally or sent a great distance;

   (d) the future of these forests.

3. THE FOREST AND ITS PRODUCTS

Level: I

Goals and objectives:

Show the utility of wood as a material;

show how this material is employed after rough shaping and after extensive processing;

list the uses of wood, forest products and the functions of the forest;

bring out the importance of the forest as an environment to be protected.

Duration: 3 or 4 sessions.

Disciplines: Biology, economics, social sciences.

Equipment:

As for normal classwork and drawing;

objects made of wood;

samples of different species of wood.

Activities:

1. At home, in the classroom or elsewhere, look for objects made of wood, such as a table, a pencil, a piano, a sailing boat, etc.

2. Taking for example, a roofbeam or a sculpture, reconstitute the history of the tree from which the wood came, starting with the seed or seedling in the forest.

3. How has the wood been processed to produce the object you have chosen? What different sorts of wood or trees do you know?

4. What will happen in the future to the object or the wood of which it is made? Try to imagine the subsequent history of the wood of which the object is made right up to the time it is finally destroyed.

5. Wood is also used to make paper: in the same way as before, imagine or reconstitute the story of the trees which helped to produce:

   today's newspaper;

   the cardboard container for your milk;

   your favourite book;

   a cardboard box.

6. Think of still other uses for wood: poles, heating, making tools, etc.

7. Role-playing: let several of you imagine yourselves as trees in the forest discussing what you would like to become. Along comes a wood-cutter who perhaps has other ideas.

8. Think of other products that the forest can offer: what can one pick, gather or hunt, etc.? What are these products used for?

9. What do you do in the forest? What do other people do there?

10. Are there any serious dangers for the forest?

Exploitation

1. For example, by making several large posters, answer the question: what purpose does the forest serve?

2. What could you yourself do to see that fewer trees are cut down and the forests thus preserved?

4. AGRICULTURAL RESOURCES FROM CROPS

Level: I and II

Goals and objectives

On completion of the following activities the pupil should be able to:

describe in writing the cultivation process for a common local crop;

identify the main type of cultivation in his area (monoculture or polyculture, intensive or extensive cultivation, etc.);

to estimate roughly the cultivated surface and yield required to satisfy the needs of one person;

to recognize the advantages and disadvantages of cultivating small plots of land using a lot of labour and highly mechanized industrial farming.

Duration: 1 to 2 weeks.

Disciplines: Geography, biology, agronomy, economics.

Equipment:

As for normal class work;

for investigations: notebooks (tape recorders).

Activities:

1. Select:

   (a) two food crops:

   one grown as near as possible to the place where you live;

   the other producing a food grown elsewhere but which you eat quite a lot of;

   (b) one crop producing something other than food. Divide the class into three groups, one for each of the three crops selected.

2. Each group will carry out an investigation among farmers, agronomists and gardeners, or look for documents containing information on:

   the various stages in the growing of the crop over the year: initial preparation of the soil; amount of attention required, harvesting, etc.;

   the purpose of the various operations;

   the equipment, materials and products, etc., used by the farmer to do his work;

   how the plant cultivated develops from seed up to harvest time;

   the part of the plant that is actually used, and what is done with the rest;

the amounts harvested per hectare;

what processing if any is carried out before it is used by man.

3. Also try to find out:

if this crop is the only one or almost the only one grown in the region where it is found (mono- or polyculture);

if from one year to the next the crop is replaced by another (rotation of crops);

if the crop is grown very carefully on small plots (intensive farming) or on large surfaces with rapid operations by big machines (extensive farming).

4. Try to work out the needs covered by the amounts harvested:

by taking account of the yield (amount harvested for a given surface area): what area would supply the amount consumed per person per year?

by estimating the number of people whose needs can be satisfied by one farmer.

5. What has to be done to ensure regular harvests each year?

6. Imagine a discussion between several characters (role-playing: 1 or 2 farmers, the local mayor, a representative of the Ministry of Agriculture, a nature conservancy warden, a dealer in agricultural equipment and products, a hunter) on a project to replace the existing cultivation of vegetables on small plots by the cultivation of large surfaces by highly mechanized industrial means (e.g. cotton, Jerusalem artichokes for the production of alcohol, etc.).

7. If possible, plant yourselves a crop in the school garden and monitor its growth throughout the year.

Exploitation

(1) Build up a general view of the economics (production, trade) of food and non-food crops in your country. On what other countries is your own dependent in this respect?

(2) What are the most important plant products for food in the world? What are the major patterns of trade involved? What is meant by the expression 'food weapons'?

5. STOCK-RAISING AND ANIMAL PRODUCTS

Level: I and II

Goals and objectives

Having studied this theme, the pupil should be able:

to identify the animal origin and the geographical source of some part of his food;

recognize that energy is consumed in the production, processing and transport of this food;

to describe the processes involved - preservation, packaging, transport, preparation, cooking - in the producer-to-consumer chain;

to have some idea of what happens to the waste products of animal foodstuffs, discarded packing, etc.;

to grasp the problem of protein production in the world and to distinguish vital needs from luxury consumption.

Duration: 4 sessions.

Disciplines: Biology, geography, agronomy, economics.

Materials: as for normal classwork and investigations (notebooks, tape recorders, etc.).

Activities :

1. Reading the labels on various foods, identify all the products of animal origin contained in them. In this way make up a full list of the animal products you eat.

2. Find where the most important of these foods come from.

3. Say what you know about how they are produced. Support what you say by photographs or articles from newspapers or magazines.

4. Working in small groups, conduct an investigation among a few farmers who raise stock in your region on:

   what the animals are given to eat and how much they consume;

   rate of growth and weight of meat/quantity of milk obtained per day;

   products needed for raising livestock;

   care of the animals;

   destination of what is produced, and transport;

   amount of land needed to feed one animal (relate to the gain in weight of that animal in a year).

5. Identify the forms of transport used to convey the product from the place of production to the place of processing and subsequently to the shops for distribution. If you can, work out the direct consumption of energy per kilo of the product.

6. Explain why it is said that the production of 1 kg of meat takes 1 litre of petroleum.

7. From the live weight of the animal work out the percentages of all the losses, including what you leave on your plate; what percentage of the animal is actually eaten by the consumer?

8. Organize a discussion on:

   (a) whether or not it is possible to be a vegetarian, strict or otherwise;

   (b) the costs of animal production in terms of energy, land and labour (distinguish between the production of milk or eggs and that of meat).

Exploitation

(1) Consider the problem of protein intake for various types of country in the world. What happens in the rich countries? In the poor ones? What diseases are connected with the consumption of or shortages of animal products? What part does this problem play in the general fight against hunger?

(2) List some of the actions to combat hunger in the world. How could you help?

EVALUATION

Questions

1. What are the characteristics of good farming land?

2. Describe what human actions are likely to render a zone infertile. State the most obvious ways in which man causes or speeds up erosion, and what can be done to avoid or remedy it.

3. Using the data on average yield per unit of surface employed in your country or region, make a rough estimate of the amount of land needed to feed one person:

   (a) on plant products alone (wheat)

   (b) with a preponderance of animal products (beef, mutton, pork).

4. List the various ways of using a forest. Give examples of its different uses.

5. What are the most wasteful uses of paper in daily life? What could be done about it?

6. What proportion of the land is used for agriculture in your country? Compare with figures for industrialized and essentially rural countries.

Multiple choice

(1) Only about ... of the surface of the earth presents no serious obstacles to agriculture:

   (a) 50 per cent; (b) 80 per cent; (c) 20 per cent; (d) 10 per cent.

(2) Major obstacles to agriculture affecting soils are:

   (a) too much water;

(b) lack of water;

(c) the presence of toxic minerals;

(d) lack of depth;

(e) lack of trace elements;

(f) none of these factors;

(g) all these factors.

(3) In the industrialized countries, built-up areas and roads cover on average ... of the area of the country:

(a) less than 0.1 per cent; (b) a few per cent; (c) over 10 per cent.

(4) To form a 1 cm layer of good earth, nature takes:

(a) over 1000 years; (b) several 100 years; (c) less than 10 years.

(5) Land is expensive because:

(a) it is scarce;

(b) property developers want to buy it;

(c) governments need it for buildings and roads;

(d) it is sought after for growing crops;

(e) industrialists want it for building factories;

(f) none of these reasons;

(g) all these reasons.

(6) Land can be made less fertile or unusable by:

(a) pollution;

(b) too much water;

(c) erosion;

(d) excessive quantities or the wrong mixture of pesticides or fertilizers;

(e) over-intensive cultivation;

(f) overgrazing;

(g) all of these causes.

(7) Overgrazing, clearing and deforestation are major causes of:

(a) erosion;

(b) the high cost of land;

(c) an increase in yield.

(8) We rely on crops to satisfy at least some of our needs for:

(a) clothes;

(b) food;

(c) paper;

(d) all of these;

(e) none of these.

Group evaluation based on activities

Choose a plot of land in your town or in the nearby countryside which is owned by the community and not used except as a rubbish dump.

Draw up a restricted development plan for growing a crop or creating an open space:

(a) if necessary, propose a plan for cleaning the site;

(b) collect a sample of the soil and find out its principal characteristics;

(c) by looking at what crops are grown round about and all the plants to be found on the site, try to determine what species could be sown or planted.

Conduct an investigation in your district to find out whether the other inhabitants would like to see your project carried out.

Get your project accepted by the local authorities; raise the minimum financial support for buying equipment, seed, etc.

Carry out your project by doing as much of the work as possible by yourselves.

CHAPTER VI

WATER AND THE RESOURCES OF AQUATIC ENVIRONMENTS

Water and living creatures

Water is a major element without which there could be no life on earth. It is present in the bodies of all living creatures (the human body, for instance, is two-thirds water), who need it to survive even if certain forms of life, such as seeds or spores, can sometimes do without it for quite long periods. All animals must find water for themselves in greater or lesser quantities, either directly by drinking it or by absorbing the water contained in their food. Plants also contain water (up to 80 per cent or 90 per cent for many of the superior species) but, more importantly, they absorb vast quantities of it - 10 to 15 tonnes a year for the transpiration of a fairly mature tree and several thousand tonnes a year for a hectare of crops.

If we include oceans and seas, more than two-thirds of the earth's surface is covered by free-standing water. All rivers and freshwater lakes, salt-water seas and oceans provide environments for a highly diverse flora and fauna, which are often very abundant in certain areas. Fishing in particular, and also the gathering of algae, provide us with an important natural resource from these environments, in addition to that constituted by water itself.

Water is also a means of transport, a 'vehicle' for living creatures:

minerals are carried to plants by the water in the soil;

food is redistributed by means of the watery liquids (blood, lymph or sap) within the body or plant;

lastly, water is often also used to discharge waste matter (e.g. urine).

To cope with the problem of heat, the most efficient mechanism for both plants and animals is the evaporation of water by means of transpiration. Man cannot survive without water: we need 2 to 3 litres of liquid a day, and the water has to be pure. In addition to being clean and agreeable to drink, it must be free of germs and parasites which could cause disease. The problems of water supply relate not only to quantity but also to quality.

The uses of water

In daily life at home, water is used not only for drinking but for many other purposes as well. The towns and even the villages of industrialized countries use very pure water, tapped at great expense in areas safeguarded from pollution of any kind and distributed by an extensive network of pipes. For some of the uses to which it is put the water could be less pure but, however this may be, after use it is carried off as sewage, i.e. polluted water containing a great deal of organic matter. The volume of water consumed in residential areas (individual dwellings) in the urban areas of the industrialized countries can be broken down by use as follows:

41 per cent for the lavatory;

37 per cent for washing (baths and showers);

6 per cent for dish-washing and preparation of food;

5 per cent for drinking;

4 per cent for washing clothes;

3 per cent for cleaning;

3 per cent for watering the garden;

1 per cent for washing the car.

Consumption per person comes to about 50 m3 a year or about 150 litres a day, but can be as much as 300 m3 for those living in individual houses with large gardens.

Each human being, especially in the industrialized countries, in fact indirectly uses a vast amount of water because many of the products he consumes require water for their manufacture:

200 m3 to make a tonne of cardboard;

500 m3 to make a tonne of printing paper;

200 m3 to make a tonne of steel;

600 m3 to make a tonne of nitrogen fertilizer.

To this must be added the water required to produce our food (irrigation, the watering of cattle) or to process it, etc., not to mention the fact that crops, grazing land and especially forests depend almost entirely on the water they receive as rainfall.

Water pollution

Water becomes polluted when it contains too much organic matter, when toxic or non-organic substances enter it, or when its temperature rises. Decomposers (bacteria) need dilute oxygen to break down waste matter, and if there is not enough oxygen in the water for the quantity of waste matter to be decomposed, the plants and other living creatures living in that water suffer and even die. Morever, if the waste matter is not decomposed, the onset of certain diseases (e.g. cholera) will be encouraged. Another danger when water is oversaturated with organic waste is that the minerals released by the waste (for example phosphates and nitrates), which are fertilizers, provoke the proliferation of plants such as algae; these, then form great quantities of organic matter, whose subsequent fermentation can destroy all forms of life (this phenomenon is called eutrophication).

Human excreta must also be decomposed. With the rapid growth of the urban population it is becoming necessary for cities to recycle sewage by artificial means.

Non-organic pollution is chiefly a consequence of industrialization: many industries need water for washing, cooling, diluting, soaking, cleaning, processing, heating and getting rid of their waste products, etc. All this pollutes the water in various ways. Thus toxic pollution occurs when dangerous substances (various chemicals products and residues, pesticides, petroleum products, etc.) or heavy metals such as lead and mercury are released into

rivers. These poison not only every creature living in the water but also anyone who eats fish taken from it (e.g. the case of Minamata, caused by waste mercury). Thermal pollution is caused by the discharge of hot water, into a river for example, which raises the temperature of the water above normal and thus disrupts living conditions.

Clearly every factory should have its own system of purification so as to return the water to the earth as pure as it was received, but it is only recently and in isolated cases that this is being done. The legislation is proceeding slowly, forcing industry to comply in varying degrees, but so long as appropriate purification systems are not compulsory, pollution will continue.

Anxious to preserve their national water resources, governments are taking an increasing number of measures both to combat existing water pollution and above all to prevent it in future.

The resources of aquatic environments

Freshwater environments (lakes and rivers) and the oceans can provide man with high quality food (fish, shellfish, etc.), which constitute a valuable source of proteins. Yet only 2 per cent of man's food comes from the oceans and sometimes the fish caught are used only for cattle feed or even fertilizer.

For those living in big cities, aquatic environments are chiefly a place of relaxation where they fish, bathe, enjoy boating or windsurfing, or simply have pleasure in contemplating waves, waterfalls, lakes, fountains, rivers and mountain torrents. All this is part of the role played by water. Humid semi-aquatic environments and the banks or shores of all aquatic environments are paid a great deal of attention by nature conservationists since they are environments particularly rich in the number of species they contain; in addition, marshes are visited by migratory birds on their passage, and serve to regulate the groundwater level. Despite all this, drainage schemes, the construction of buildings too close to the shoreline and all kinds of pollution cause very serious damage to aquatic environments and spoil the quality of the water which is necessary to us. The importance of aquatic environments and humid zones is nevertheless now being more and more clearly perceived and many efforts are being made to preserve them both qualitatively and quantitatively.

ACTIVITY NOTES

1. WATER IN EVERYDAY LIFE

Level: I

Goals and objectives:

Make pupils realize the importance of the water used everyday;

show the variety of its uses;

reconstruct some stages in the water cycle after the water has been used.

Duration: 1 session of 2 to 3 hours.

Disciplines: Natural sciences, social sciences.

Equipment: as for normal classwork and drawing (large sheets of paper, crayons).

Activities:

1. Try to recall everything you have done since getting up this morning which required the use of water.

2. Imagine that every time you use some water, that water includes a drop which is able to tell you its impressions (you could imagine that all the drops of members of the 'Aqua' family and even give them names). For each use of water, draw the drop you are thinking of, showing its first reaction to what you are going to do to it (cheerful, not very pleased, worried, etc.).
   You could also:

   colour each drop to show what it is being used for;

   draw drops of different sizes according to the amount of water needed for each use.

3. Try to think what happens to the drop of water afterwards. Where does it go? What will be its reaction then (still pleased, very angry, etc.)?

4. To sum up your replies to Nos. 1, 2 and 3, make out a table something like this:

Place (part of the house)	Time	Use of the water	1st reaction of the drop	Its destiny	Next reaction

5. Make a drawing in two parts:

   (a) On one side, draw your house or flat with its various rooms; mark with coloured 'drops' the places where water is used and where it is discharged afterwards;

   (b) on the other side, draw a landscape with some fairly distant places where the waste water might go. Plot the various 'drops' (showing their reaction and colour) on this landscape.

Exploitation

Discuss together the following questions:

(1) Which are the household uses that require the most water?

(2) What should drinking water be like?

(3) What is meant by sewage?

(4) How much water do you need when you go camping?

(5) How can you save water at home?

2. THE USE OF WATER IN THE HOME

Level: II

Goals and objectives

Make a rough estimate of the amounts of water consumed by a household, in general and for each use;

identify the most wasteful uses;

consider possible savings by individuals and families;

highlight the concept of quality of water.

Duration: 2 sessions of 2 to 3 hours (4 sessions when Exploitation No. 5 is included).

Equipment: as for normal classwork and drawing.

Activities:

1. Draw a plan of the water system in your house or flat, from its point of entry to the disposal pipe or pipes.

2. Do you have any means of knowing the amount of water used in the course of a year and the average consumption per person per day?

3. Could you make a list of the uses of water in your home and calculate the quantity needed for each of them (dish-washing, lavatory, showers, baths, etc.)? In some cases you could do this by calculating the volume of the recipients which contain or receive water at given times. Look also at the instructions for your household appliances since they sometimes indicate the amount of water consumed each time the machine is used.

4. Draw a circle to represent the 'slices of a cake', i.e. with each 'slice' indicating the amount of water, as a percentage of the total consumption, used for each purpose.

5. How could you save water, especially for those uses which require the greatest volume?

6. What is the quality of the water when it reaches your home?

7. In what forms is it discharged? What does it then contain? What happens to this waste water?

8. Could you imagine or do you know of any ways of re-using this waste water?

Exploitation

(1) Compare the consumption data per use you have worked out with the averages given in documents.

(2) Try to work out the amount of water that your country could save in relation to its present consumption if the means you have considered for your own case were employed by everyone.

(3) What are the obstacles to these ways of saving water?

(4) What conditions are needed to obtain water of the quality you receive? Where does this water come from? How does it get to your home?

(5) Working together, prepare two or three posters to exhibit your findings to your parents by way of diagrams, figures, drawings, photographs cut out from magazines, etc.

(6) Find the figures for water consumption per sector (domestic, agricultural, industrial) and the total consumption for your country. Work out the average consumption (direct and indirect) per person.

3. WATER AND AGRICULTURE

Level: I and II

Goals and objectives

Show that water is an indispensable resource for agriculture;

show the respective contributions of rainfall and irrigation;

bring out the inequalities between regions in the world with respect to water resources and the terrible consequences of drought.

Duration: 3 to 4 sessions.

Disciplines: Biology, geography, agronomy, economics.

Equipment:

As for normal classwork;

documentation.

Activities:

1. Calculate the annual rainfall received by one hectare of corn; if a hectare produces 4000 kg of wheat, how much water is required to produce one kilo of wheat?

2. Is it possible to grow crops in places with little or no rainfall? How?

3. Do all crops have to be irrigated?

4. Find out how various crops (market garden produce, a field of corn, etc.) are watered.

5. If there is a dry season and no irrigation, how does the crop then react?

6. Have you any idea of the amount of water consumed by the cultivated surface of your country?

7. In the case of stock-raising, how much water do the animals need each day? Where can they find this water?

8. Is there any connection between water pollution and certain farming practices?

Exploitation

The consequences of drought: find documents on the subject concerning the Sahel. Discuss the role of water in the lives of the populations affected. Compare this with the role of water in your own daily life and in the economy of your country. Do people sometimes speak of drought in your own town or country?

4. WATER IN NATURE AND IN HUMAN ACTIVITIES

Level: I

Goals and objectives:

Determine the role of water in nature and in man's activities, and show its importance;

describe the water cycle.

Duration: 2 sessions of 2 to 3 hours.

Disciplines: Natural sciences, social sciences.

Equipment:

Photographs cut out from magazines;

prepared sets of cards;

drawing equipment.

Activities:

1. Find documents (photographs or drawings) illustrating occupations which utilize water.

2. Ask people in your neighbourhood, people who work in factories for instance, whether water is needed to make paper, steel, leather, etc., to generate electricity, refine oil, and so forth. If you can, try to draw the water circuit for a particular factory in your region, from arrival to discharge. (In what state is it when it arrives and in what state when discharged?)

3. What happens to the rain that falls in the countryside? Why do farmers or stock-breeders complain when it does not rain enough? Why are gardens, and sometimes crops, watered?

4. Let each pupil take at random one of the following cards, representing a photograph or drawing of:

a stretch of water with water-lilies;

a baby crying;

a dam for generating electricity;

rain falling;

a bathtub;

a bottle of wine;

the sea;

fruit;

snow.

Imagine that each of these pictures contains a drop of water belonging to the 'Aqua' family (if you like, give it a name); try to retrace its life up to its arrival there and to explain what will happen to it afterwards. To do this, place your card in the middle of a long roll of paper and make drawings from left to right to show what happens to the drop before and after.

Exploitation

(1) Working together, draw a very big landscape with clouds, mountains, rivers, lakes, fields, factories, the sea and so on (i.e. everything mentioned in the story of the 'Aqua' drops), and then draw in the journeys made by the drops by putting some along each route taken - light-coloured drops if the water is pure and dark-coloured if it is polluted.

(2) Look up a book for a picture showing the water cycle. Compare this with your drawing. Discuss.

5. THE RESOURCES OF AQUATIC ENVIRONMENTS

Level: I and II

Goals and objectives

On completion of the activities, the pupil should be able to:

identify and distinguish the various aquatic environments;

describe the main types of fauna and flora in one or more of these environments;

recognize the natural role of these environments;

describe how man makes use of them and the consequences of what he does.

Duration: a 1 day outing and 4 to 5 sessions in the classroom.

Disciplines: Biology, geography, economics.

Equipment:

For collecting samples and site observation;

geographical and geological maps;

drawing equipment;

documentation to be compiled.

Activities :

1. Make a list of all the fresh- or salt-water environments you can think of.

2. On a map of the region around your own town or village, find the various aquatic environments that are marked.

3. Choose one (or two) aquatic environments not far from the school and organize an outing to study it (topography, vegetation, animal life, quality of the water; impact of man, fishing, recreation, etc.).

4. On a map of a suitable scale, use symbols or coloured spots to show where particular plants are found; make a list of the main animals, choose a sign for each species and plot on the map.

5. What use does your local community make of fresh- or salt-water environments?

6. The same question for other parts of your country and for the world. Do there exist populations for whom the aquatic environment is much more important than it is for others? Find pictures or texts showing this.

7. Fish supply us with a certain amount of special foods (proteins) which are the same as those obtained from meat. What types of fishing do you know about? How much direct or indirect energy and what raw materials are needed for these methods of fishing? Study two, if possible very different, examples in detail (level II only).

8. Does water exist that cannot be seen on the surface? Is it important for us? Discuss.

9. What are the humid zones? What animals frequent them? What purpose do these zones serve?

10. Why are the effects of water pollution so serious? What are the most common types of pollution?

Exploitation

Make large exhibition panels illustrating the resources (and showing the amounts) of:

(a) the sea;

(b) fresh water

for either a particular country (your own if possible) or the world as a whole.

Find press articles about the hopes raised by exploitation of aquatic environments. Discuss the conditions that must be met for their more effective use.

EVALUATION

Questions

1. Is water a renewable resource?

2. What factors impair the quality of water? Do you 'dirty' the water you use every day?

3. What proportion of your body is made of water?

4. What elements in nature contain water? Are there some which contain no water at all?

5. In what way is water essential for our survival?

6. Where does the water you use every day come from?

7. In what way can water be used to produce energy?

Multiple choice

(1) The volume of water on the earth is:

   (a) infinite;

   (b) negligible;

   (c) almost entirely made up of the oceans.

(2) Water is ... for agriculture:

   (a) superfluous;

   (b) essential;

   (c) useful but not essential;

   (d) employed only in irrigation,

(3) Industrial pollution of water can ... life in rivers and lakes:

   (a) contribute towards;

   (b) develop;

   (c) kill.

(4) Fresh water can be obtained:

   (a) in unlimited quantities;

   (b) only in certain places;

   (c) even after all the uses we put it to;

   (d) easily from seawater.

(5) Water pollution as a result of domestic and industrial use is:

(a) inevitable;

(b) avoidable with proper preventive measures;

(c) of no importance.

(6) Water is ... for making steel:

(a) of no use;

(b) sometimes used;

(c) always used.

True-false

1. A person needs to drink two litres of water a day.
2. The consumption of water per person per day in an industrialized country is betwen 150 and 250 litres.
3. 300 litres of water are needed to obtain a kilo of wheat.
4. Industrial pollution of water is a necessary evil.
5. There is an unlimited volume of fresh water deep down in the earth.
6. With special techniques, water could be replaced with something else.
7. Water is not essential for all forms of life.
8. There is very little water in a wooden table.
9. Petrol could be replaced as a fuel by water.
10. Great quantities of water are wasted every day.
11. Water is the source of all forms of energy.
12. All things, including stone and steel, etc., contain water.
13. Water is indestructible.
14. Water is one of the most common solvents.
15. Almost all industries use water.
16. Most fish live only in the water.
17. Pollution does not affect the chemical structure of water.
18. Water is used for cooking and cleaning.
19. Water is a living substance.
20. Water has a special taste.

Group evaluation based on activities

1. Imagine all the things that could be done to save water in a small group of houses or block of flats. (Do not overlook the possibilities of re-use, of recovering rainwater or of organizing differently). Make practical proposals to the residents.

2. Imagine that you are the municipal council of a small rural town which has however a small industrial complex. What measures should be suggested to farmers, the industrialist and the residents to save water and avoid polluting it? If possible, compare your results with the actual measures adopted by your local authorities (discuss with one of the persons responsible for these problems).

CHAPTER VII

ENERGY

Different forms of energy

Although the word energy is common and not regarded as a technical term, a glance at any dictionary will show that the definition given does not really tell the non-expert very much. He will see that the definition is usually backed up immediately by a list of the different forms of energy distinguished by physicists - mechanical, thermal, electrical and chemical energy.

What each person understands by the word energy is in fact often vague, and different groups of people look on it differently. Everybody, however, finds it easy to state the forms in which energy is used (electricity, petrol, fuel oil, coal, gas, wood, manure, etc.) for various purposes such as:

heating (for homes, hot water, cooking food, industry, etc.);

driving motors, whether fixed in place (machines) or mobile (vehicles for transport);

lighting.

A less widespread concept is that of the energy value of our foods (more usually called the caloric value), which is basically responsible for the functioning of the biological machine that is our body and makes movement, effort and work possible; we derive this form of energy from the resources of agriculture and stock-raising. It reaches us in the form of what is called potential chemical energy, which we then convert into heat (heat energy) through our respiratory exchanges. The mechanical energy of a draught animal is also derived initially from what it eats.

Energy resources

Nowadays both animal draught and human effort for mechanical purposes are not nearly as important as they used to be, and when we speak of energy in an everyday context we do not generally have those types in mind.

The major sources of energy in the industrial world are essentially the fossil fuels - coal, oil and gas. The relative ease with which they are obtained and their great convenience of use after relatively little processing are advantages which are unfortunately counterbalanced by the fact that they are non-renewable. Formed over long periods of time in sometimes very distant geological eras (the primary era, especially for coal in Europe) and only in certain zones, these fuels, once they have been used, persist only in the form of carbon dioxide discharged into the atmosphere. The worldwide renewal of these fuels is so slight in relation to the quantities consumed that no allowance at all can be made for it. On our human scale, therefore, these resources are non-renewable and exhaustible; at most, we can hope to use coal that is a bet more difficult to mine, or lean ores with low yields (oil shale) - but obtained at a higher cost in energy!

The other two main sources of energy are nuclear fuels (uranium and plutonium) and hydroelectric energy, which is based on the climate (rainfall), hence theoretically renewable but in fact limited by the restricted number of possible sites for dams and the lifespan of these dams (silting up).

What we call new forms of energy - solar energy, the biomass (wood, agricultural residues such as straw, etc.), tidal energy and the wind - are renewable and, in the case of geothermal energy, practically inexhaustible. However, there are only a few places where the tides are really suitable; similarly, for wind and geothermal energy some sites are better than others, and local use is the most logical answer in their case. As for solar energy, we are all familiar with the geographical and seasonal distribution of sunshine: it is found everywhere, but in a diffuse form which requires both captors and a means of concentrating the energy; this makes it more suitable for local use. Biomass has to be gathered and conveyed over varying distances to the place where it is used; it is renewable, but that does not mean it is inexhaustible, since one can take from the environment only the quantity of organic matter formed (productivity) which leaves the ecosystem undiminished as a producer: 'you collect the interest but without disturbing the capital'. This may be called a limited resource in the sense that agricultural land cannot in fact be expanded at will, because energy crops compete for the soil with food crops and because agricultural residues may have other uses apart from energy and always contain fertilizing elements which must go back to the soil.

Forms of energy consumption

The energy from these resources reaches us, as consumers, in usable forms such as gas, petrol, coal and electricity. Even when this transfer involves almost no processing of the basic product (as with coal or gas, for example), some energy has to be consumed for transport, the manufacture of gas pipelines, etc. An oil-fired electric power-station is usually considered to operate at about 30 per cent efficiency; in other words, to obtain one unit of electricity, which is a secondary form of energy, it consumes three times as much of the primary energy initially available, the losses taking the form of heat dissipated by the power-station (in some cases, however, this heat is recovered). This example shows clearly that, even at the generating level, there is a price to pay for the convenience and pollution-free nature of electricity to the user.

The same source of energy may be transformed for use into various products: the energy from coal is supplied to us not only directly, for burning in a stove or fireplace, but also in the form of gas and electricity (and even liquid fuel). Conversely, a particular form in which energy is used may sometimes derive from several different sources: electricity is generated for us from the water in dams, from the nuclear energy in uranium, and from the burning of coal, oil and even city refuse. The energy consumed per economic sector is a very important factor in the economic life of a country; it is closely related not only to the various types of industry (to obtain and process metals and raw materials) and the amount of transport involved, but also more generally to the lifestyle and organization of society as a whole (amount of energy consumed in the home, for leisure activities, the degree of development of the country's tertiary sector, etc.).

The big industrial societies could not have developed without the use of increasing quantities of energy, the most important sources of which have changed in the course of history: first it was wood, then coal, now oil. After a period of more than a century characterized by a very rapid pace of development with an ever-increasing consumption of energy, the oil crisis has made it necessary to consider policies aimed at the more efficient management of resources: the fight to reduce wastage, the saving of energy, the search for new technologies, the effort to make use of alternative and renewable forms of energy, etc.

ACTIVITY NOTES

1. ENERGY IN THE HOME

Level: I and II

Goals and objectives

Weigh the importance of energy in one's daily life at home;

Identify the forms of energy used in daily life (excluding the basic source of energy, namely food).

Duration: 2 to 3 sessions

Disciplines: Physical sciences, geography, economics, drawing, social sciences.

Equipment:

For note-taking and drawing;

Dictionaries, encyclopaedias and reference books on energy.

Activities:

1. Divide the class into several groups:

   (a) one or more groups will look for sentences containing words such as 'energy', 'energetic', 'energizing', etc., ... perhaps even 'energy-consuming';

   (b) another group or groups will look for the definitions of these words in dictionaries or other works;

   (c) two (or more) other groups will look for objects used at home which 'work' or function with the aid of 'something'.

2. With this information, try to identify the forms in which the energy is used and the purposes it serves. To do this, you could draw a comic strip illustrating your day from the time you get up and showing all the occasions you use energy.

3. Imagine a day without electricity.

4. Imagine a month without electricity. With what would you try to replace this form of energy in its various uses? (Draw another comic strip to represent the new situation.)

5. How does energy reach your home?

6. Find out the basic resources needed to obtain this energy.

7. Using bills paid by your parents, find figures for the amounts of energy consumed so that you can measure how much is used in your home (coal, gas, electricity, fuel oil, etc.).

Exploitation

For your parents and members of the local community, prepare an exhibition on the use of energy in the home. Here are some ideas to consider:

(1) On a map of your country (or of neighbouring countries as well if necessary), show where the energy you use is produced (e.g. hydro-electric power-station) and the route it takes to get to your home (power lines, etc.).

(2) On a plan of a house, show all the spots at which energy is used (e.g. electric plugs, gas taps, etc.), the machines employed and their functions, etc.

(3) Explain how energy could be saved in your home.

(4) Describe some alternative solutions for certain uses of energy.

2. ENERGY OUTSIDE THE HOME

Level: I

Goals and objectives

List the main types of energy use apart from direct consumption in the home.

Make pupils understand which forms of energy consumption in a particular society concern the individual - even if indirectly.

Get the pupils to imagine possible sources of energy other than the ones most widely employed today.

Duration: about a week.

Disciplines: Geography, drawing, social sciences.

Equipment:

As for normal classwork and drawing;

Documentation.

Activities:

After dividing the class into small groups:

1. Make a very big map of your district or of your village and its surroundings; sketch in very simply in black its main features (excluding people).

2. Draw in red whatever needs energy to work; in orange whatever has required energy for its production; in blue whatever has required no energy for either its production or its operation; whatever has been manufactured solely through human labour; mark with a violet cross the things that can 'work' with human or animal muscle power.

3. If you like, add little symbols to show what form of energy has been used.

4. Discuss the different results obtained by the groups.

5. Try making another map for a society different from your own or for a community in former times (in prehistoric times, in the middle ages, etc.).

6. Choose a large manufactured object, such as a car, and try to retrace the energy chain and the history of the materials required to make it. Do this by means of a large diagram showing, at each stage in the process, the raw materials needed, the energy consumed and the amount of manpower required.

Exploitation

(1) Look for documents which indicate the consumption of energy for each economic sector (agriculture, industry, transport, etc.) and produce a display panel giving a simple presentation of the results.

(2) Examine which new forms of energy could be used to replace exhaustible sources of energy (e.g. geothermal energy, the wind, solar energy, the biomass). For each case make a brief list of the advantages, disadvantages and potential difficulties of introducing them.

3. TRANSPORTATION

Level: I and II

Goals and objectives:

Identify the means of transport used.

Compare and classify the energy needs of each means of transport.

Consider possible ways of saving energy.

Duration: 3 to 4 sessions, more if out-of-school meetings with local officials or visits can be arranged.

Disciplines: Geography, mathematics, physics, economics, history.

Materials:

Maps of the district and of the town.

For drawing and taking notes.

Activities:

1. Draw on a map the routes some of you take to go from your homes to school; indicate the means of transport used.

2. For one or more routes compare the direct consumption of energy per person for different means of transport (on foot, bicycle, moped, car, bus or train), bearing in mind the amount of energy consumed and the number of passengers carried.

3. Another idea is to estimate the indirect energy costs from the weight of the vehicle used and the length of its life; to do this, find out the amount of energy needed to produce a ton of steel.

Classify the different means of transport according to the amount of energy saved by each. Also discuss the use of these means in the light of the distance to be travelled, or their various advantages and drawbacks.

4. For your town, district or village and its surrounding area, gather all the information you need to work out a transport system and a plan to save energy. For example, what should be done to make it possible to cycle to school? Who in your district, town or village is responsible for traffic or transport problems? Try to meet the local officials so that they can explain to you the difficulties, constraints, options and future projects.

Exploitation

(1) Organize in the classroom a discussion on transport problems and the related question of energy consumption as they concern:

(a) you yourself directly as a member of your community;

(b) the economy of your country as a whole.

(2) Think about how the salient features of your civilization (such as the importance of the car) influence the management and conservation of non-renewable resources.

4. HISTORY OF OIL UP TO THE PRESENT TIME

Level: I and II

Goals and objectives:

Learn more about:

the formation of oil;

its extraction, transport and processing into end-products, and the final destination of the products.

Show the role of oil in the life of industrialized countries.

Gauge the full impact on the environment of the use of oil.

Duration: 2 to 3 sessions.

Disciplines: Geology, physics, chemistry, geography, economics.

Equipment:

Geological and political maps of the world.

For drawing and making posters.

Magazines, newspapers and other documents about oil.

Activities:

1. Divide the class into several groups to find answers to the following questions: From what and how is oil formed? How many centuries does this take? What conditions are necessary for its formation? Where is oil located? How are the deposits found?

   Once this information has been compiled, draw a large map of the world and mark in the oilfields; for each country, draw a circle in proportion to the amount it produces.

2. Using pictures and information about oil from magazines, newspapers and other sources, including diagrams and drawings, make a collage to show how oil is extracted in a particular country (Saudi Arabia for example) which supplies your own country. On a map of the world, mark the routes taken to transport it to your country.

3. Find photographs or drawings showing tankers, loading, unloading and cleaning operations, and accidents which have caused oil slicks.

4. Retrace the history of an 'oil slick' and its consequences for the beaches, plants and animals affected. Identify the authorities and different levels of responsibility concerned, and try to imagine laws or alternative or better methods which would prevent it from happening again.

5. In small groups, find out what products or objects besides petrol and fuel oil are made from oil, beginning with those you use in everyday life. Group these objects into categories. If you can find statistics on the amount of oil used for each of the categories, calculate the corresponding percentages.

6. Conduct a survey in your neighbourhood to find out whether your family, friends and neighbours are aware of the origin of certain products or objects made from oil.

7. Choose a few products or objects and reconstitute as accurately as possible the story of their life from crude oil right up to their recycling or final destruction. Is there pollution at every stage?

8. What are the characteristics of oil that make it an energy source easy to use ... and to waste?

Exploitation

Construct 'scenarios', i.e. imagine what would happen in the more or less distant future for your country;

(1) if there was suddenly no oil at all;

(2) if the quantities supplied gradually fell to nothing after a few decades. Think about substitute forms of energy. Express your findings in the form of:

- written texts ('stories');
- a play in which the characters are officials and different categories of citizen;
- drawings or comic strips.

5. NUCLEAR ENERGY: HOPES AND FEARS

Level: II

Goals and objectives:

Show that options depend both on technical considerations and on the acceptance of certain risks.

Bring out the difficulties of assessing the risks objectively.

Present pupils with an example of a complex topical issue which constantly calls for value judgements concerning the various arguments.

Highlight the long-term consequences of present actions, thus bringing out our obligations to future generations.

Duration: 1 to 2 weeks.

Disciplines: Physics, biology, geography, economics.

Equipment: Mainly documentation, to be compiled and organized.

Activities:

1. Collect basic information on the principle of the use of nuclear energy, the availability and renewability of the resource employed (uranium), the practical techniques and problems involved, the economic aspects, the effects on health, the risks, the problem of nuclear waste, the siting of nuclear power-stations, etc.

2. Plan a debate with the purpose of:

   distinguishing the arguments for and against;

   separating the economic arguments from the risk factor;

   analysing the reasons advanced for and against specific options;

   gaining an overall view of the consequences, both the irrefutable and the hypothetical.

3. The debate could take place in the classroom along role-playing lines; the following notes might serve as a starting point for the different attitudes:

   (a) a worker:

   I earn my living comfortably ... I don't know if I could find another job. I admit it's dangerous but I've got to have a livelihood.

   (b) an ecologist:

   There are no grounds at all which justify the risks involved in nuclear power-stations. Even if the risk of an accident is minimal, and that of a really serious accident mathematically impossible, there is no escaping the fact that reactors produce types of nuclear

waste (such as strontium 90 and caesium 137) which remain radioactive for at least 30 years, and others for a much longer time; and that we do not know what to do with this waste, which is at present being stocked in the hope of finding a way of getting rid of it at some future date.

(c) a local inhabitant:

People say that radioactivity is very high near power-stations ... and that it can cause cancer and malformations ... There was a study made in the area of the Hanford atomic power-station, which is situated on the Columbia river in the north-west of the United States; this showed that the radioactivity of the local plankton was two thousand times that of the water, that of the fish four hundred thousand times higher, that of insect larvae three hundred and fifty thousand times higher and that of the birds which eat large quantities of the larvae five hundred thousand times higher. This frightens me, not only because we live by a great river but also because a large proportion of what we eat comes from our garden, and we sell a lot of our produce too. When I think of the effect that could have on children ...

(d) a government representative

Although further research is still needed, nuclear power justifies us in thinking that, in the event of an oil crisis or other form of energy crisis, we will not collapse into complete paralysis. By 1985 we hope to obtain 80 per cent of our electricity needs, i.e. 25 per cent of our total energy requirements, from nuclear power. Nuclear power is an absolute necessity. With hydrocarbons running out and new forms of energy not developing quickly enough, it will cover the period of transition and be indispensable for about 50 years to meet the needs of industrialized countries. It took no more than a partial stoppage in the production of oil and a severe winter to show up the shortcomings of our supply system. We cannot do without nuclear power.

(e) a consumer wanting to maintain his standard of living

Yes, I am in favour of nuclear energy. I know there are certain risks, especially for those employed in producing it. There are the problems of radioactive waste, and its transport and storage. But if you asked me to choose between cutting down my consumption of energy by at least three-quarters or using the energy from nuclear power-stations, I would opt for the latter. I don't know how I could manage with very little energy - no car, no record-player, none of the gadgets or machines I use every day, not to mention my stereo, television and radio. It would be like wartime or the 'good old days'. It might mean a return to a healthier and happier life ... but as things are I would rather keep up my standard of living.

(f) an historian passionately interested in the future

I am interested in figures, and here are two from what I have read: a reacter supplies power for 20 years but the waste will take 2,000 years to lose its radioactivity. For example, if the ancient Romans had built such power-stations, Europe would still be busy today

monitoring the cooling of their waste products. What kind of gift are we preparing for our grandchildren, our great-grandchildren and our great-great-grandchildren? Is it not a poisoned gift?

6. NEW FORMS OF ENERGY

Level: II

Goals and objectives

On completion of the activities, the pupil should:

have a clear idea of the practical possibilities of the so-called new forms of energy;

be able to construct simple models and possibly take measurements from them;

know how to propose and carry out a practical piece of work.

Duration: several weeks (especially for models).

Disciplines: Physics, chemistry, handicrafts, biology, economics.

Equipment:

Documentation;

Wood, plastic bottles, tubes, sheets of glass and copper, thermometers, black paint, etc.

Activities:

1. Do all the so-called new sources of energy (excluding nuclear energy) deserve to be called 'new'? Consider the case of:

   (a) direct use of the sun;

   (b) solar energy via the 'biomass' (wood and the residue of sawmills, agricultural residues and organic household rubbish, etc.);

   (c) geothermal energy (the heat contained in the earth);

   (d) the tides.

2. How can we tap the potential energy contained in these sources? What are the methods available to us? What are the forms of energy obtained and what would they be used for?

3. Are these resources renewable or non-renewable?

4. In tapping these sources of energy, is it intended to encourage their use for local needs or on the contrary to build powerful plants distributing energy over relatively great distances?

5. Why do people sometimes speak of alternative energy?

6. Make some experiments: build working models to demonstrate how energy is in fact tapped or obtained from these sources.

Exploitation

Display your results and models for the benefit of members of your community.

Propose a practical scheme for your school or a public building using one of these forms of energy; examine the conditions for installing it; see what officials and the local inhabitants think of your proposals; try to get them accepted, and take an active part in carrying them out.

EVALUATION

Questions

1. Physicists distinguish different forms of energy which can be transformed one into another. What are these forms?

2. What are the different forms in which energy is supplied to consumers?

3. What are the basic resources from which energy is obtained?

4. How can renewable sources of energy be distinguished from non-renewable sources? Give some examples.

5. What forms of energy are used in transport today? In former times?

6. In your country, what sectors are the biggest consumers of energy?

7. What is the total energy consumption in your country? What is the average consumption per head of the population?

8. What approximately, is your direct personal consumption?

   Indirect consumption?

   Add the two together and compare with the consumption per head of the population.

Multiple choice

1. Fossil fuels are ... forms of energy.

   (a) poor; (b) concentrated; (c) renewable; (d) inexhaustible.

2. Pollution (industrial, domestic and from the consumption of energy by vehicles) ... a necessary evil.

   (a) is; (b) is not; (c) is perhaps; (d) neither (a), (b) nor (c).

3. Our energy needs are ...

   (a) the same for everyone; (b) always the same; (c) an inherent factor; (d) largely artificial.

4. The new energies can be produced ...

   (a) only by creating a lot of pollution; (b) without creating pollution (or creating very little); (c) neither (a) nor (b).

5. Wind is a form of solar energy resulting from ...

   (a) the motion of the sea; (b) differences of temperature in the air; (c) the gravitational pull of the moon.

6. Solar energy must be ... to serve as an alternative source of energy.

   (a) cooled; (b) captured and if possible concentrated; (c) heated; (d) turned into electricity.

7. The forms of energy to be found in the oceans are ...

   (a) the wind; (b) shellfish and algae; (c) the tides; (d) hydroelectric energy and electricity.

True or false

1. Energy is essential for communications and transport.

2. The production of energy always consumes non-renewable resources.

3. Our society cannot do without cars.

4. Certain societies use neither fertilizers nor machines in their agriculture.

5. The use of fertilizers and machines does not consume energy.

6. Many kinds of waste matter can be used for producing energy.

7. Recycling metals is not a way of saving energy.

8. It is possible for motor vehicles to use less energy.

9. Goods cost more to transport by rail than by road.

10. Energy cannot be produced without causing a lot of pollution.

11. Natural renewable energy resources, such as firewood, are only renewable if their use is planned in a rational manner.

12. Economic growth and the demand for energy are at present inextricably linked.

13. The energy contained in uranium is in an even more concentrated form than that contained in fossil fuels.

14. Uranium is an inexhaustible resource.

CHAPTER VIII

ORES AND METALS

In recent years several reports (the one by the Club of Rome, for example) have drawn attention to the danger of certain metals running out. As a matter of fact, most of the estimated dates for exhaustion put forward are based on hypotheses regarding the volume and rate of consumption for the resources in question (for instance, the consumption of copper is assumed either to increase, to remain stable or to decrease in the decades to come) and the 'exploitability' (in economic and technical terms) of the deposits so far known. We therefore need to have some basis for a judgement before jumping to the conclusion of a catastrophe in the future. Above all, the concept of 'exploitability' must be made clear so that the problems related to mineral resources can be properly grasped.

From ore to metal

Ores are rocks with a high concentration of the metal that is wanted, and this metal content is a vital factor for determining whether or not the mining of a deposit is economically worth while; there may be other factors too, such as the distance from the places where it is processed and used. Obviously, the problem of energy is immediately involved since the mining, transporting and refining of the ore into metal all consume energy. It is in fact well known that there exist considerable reserves of mineral resources, provided that enough attention is paid to prospecting and to improvements in the mining of deposits and use of the metals. The real limit to the consumption of mineral resources would therefore seem to be the future availability of energy.

It would be misleading to make calculations in order to prove that the oceans contain enormous quantities of copper; if we really wanted to extract the copper from seawater, which has an extremely high copper content, we would have to consume considerable amounts of energy.

In our attitude to resource management we must include the concept of the cost of energy required as well as the idea of scarcity. For example, aluminium is obtained from bauxite (an ore with a high aluminium content) but its production requires far more energy than in the case of other metals such as iron; if we had to use bauxite rich in aluminium yet with a lower content than the ores now employed, the energy requirement would rise still further. On the other hand, the melting of scrap aluminium does not require much energy. Here anti-corrosion measures and the melting down and re-use of processed metal should be strongly encouraged. Many countries have in fact begun to do this, given the fact that there is now a real awareness of the scarcity of certain metals.

Metal: from use to recycling

The crude metal is extracted from the ore and then shaped into the object wanted - always at the cost of a certain amount of energy. At these stages the metal is at its maximum concentration since it has been purified of all dead, or worthless material. It can happen that the metal is dispersed once again; if an object made of iron is allowed to rust, the particles of iron oxide may be carried away by the wind or water, but even when the object retains more or less the same weight, it is often submerged in a great pile of rubbish or, if it is bulky, simply dumped as useless. A rubbish tip full of tin cans is

equivalent to a deposit of low-grade ore; by contrast, a graveyard for cars is a highly concentrated source of metals. Although there are real obstacles to recycling (problems of collection, transport, the mixture of metals in alloys and the variety of different materials employed to manufacture an object), a collective effort could be made to avoid the dispersion or useless piling-up of discarded manufactured objects.

ACTIVITY NOTES

1. METALS IN OUR LIVES

Level: I

Goals and objectives

On completion of the activities the pupil should be able:

to evaluate the role of metals in his life;

to give a brief description of the chain of processes from ore to manufactured object;

to gauge the role of energy in the various processes;

to understand why metals are relatively rare and the need to recycle and avoid wasting them.

Duration: 2 to 3 sessions.

Disciplines: Physics and chemistry, geography, natural sciences.

Equipment:

As for normal classwork.

Metal objects, samples of different metals.

Activities:

1. Do you use metals? Which ones? In the form of what objects?

2. Could you travel without using metals? What forms of transport require metals? Make a list of them.

3. What are urban networks for gas, telephone, water, electricity, etc. made of?

4. Look in the dictionary for the names of metals and classify them into three groups: those you know well, those you know less well and those you know very little about. Which are the ones called rare? Why?

5. Where do these metals come from? How are they obtained? What becomes of them when one throws away or destroys the objects made from them?

6. What is an ore? How does it differ from other rocks?

7. Work out the chain of processes from iron ore to an iron object in your possession. To do this you could, for example, draw a comic strip. Use a red arrow to mark each time energy was needed to carry out the processes required at each stage.

Exploitation

Try to find an object in your surroundings that is made of or contains each of the metals mentioned.

If the object is small and not too fragile or precious, bring it to school; if you cannot, bring a drawing of it.

Put a label on the object stating the name of the metal, the name of the ore and, if you know it, where the ore comes from.

2. WASTEFUL USES OF METALS (GAME)

Level: I

Goals and objectives

To make pupils aware of the widespread use of metals in various sectors; also of wasteful uses.

Duration: The game can be played several times during a lesson.

Disciplines: Natural sciences.

Equipment: A set of cards to be prepared.

Activities:

1. Prepare a set of 28 cards in seven groups of four cards each showing an object made of metal:

   (a) war: gun, tank, plane, bomb;

   (b) transport: car, aeroplane, bus, train;

   (c) packaging: tin can, aluminium foil, a drum of car oil, a can of beer or fruit juice;

   (d) household appliances: vacuum cleaner, washing machine, refrigerator, cooker;

   (e) games and pastimes: roller skates, skis, toy cars, bicycle;

   (f) precious objects: coins, watch, statuette, necklace;

   (g) tools: pliers, hammer, saw, screwdriver.

2. Each card should contain a picture or drawing of the object and a number (or dots) representing roughly the amount of metal used to make the object (in tonnes, kilos or grammes).

3. Four players draw six cards each, leaving the remaining four cards on the table. In turn each player discards two cards and takes two others. The first player who succeeds in collecting one of the groups of metal objects stops the game. He then discards two cards and the other players do the same. The winner is the person who has the lowest total of points from the four cards left in his hand.

4. Discuss how you fixed the number of points for each card: for example, a train is very heavy but can carry a lot of people; packaging is light but you may sometimes throw away several items in a day; your father's hammer used to belong to your grandfather and is a tool which you do not use every day.

Exploitation:

Think about the savings in metal that would be the easiest for you yourself to make, and those that would economize the largest quantities in your country and the world.

3. WHERE ARE METALS FOUND?

Level: I

Goals and objectives

Draw attention to various uses of metals which are not immediately obvious.

Show the importance and necessity of metals in our civilization.

Get pupils to reflect about the need to economize and recycle metals, etc.

Duration: 2 to 3 sessions.

Disciplines: Social sciences, drawing.

Equipment: As for normal classwork and drawing.

Activities:

1. Each pupil draws his own home as if it had been X-rayed (X-rays shows up metals) and uses different colours to indicate:

   (a) the electrical circuit;

   (b) the plumbing system;

   (c) the metal used in the building itself (reinforced concrete, etc.);

   (d) the metal used for windows, doors, balconies, etc.;

   (e) the household appliances (represented by simple symbols).

   This could also be done by room: kitchen, bathroom and so on.

2. What are the metals used? Iron, cast iron, steel, copper, lead, aluminium? Could you roughly estimate the weight of these metals in a house or flat?

3. To identify the small metal objects a person wears, imagine X-rays of various people in the street (a schoolboy, a well-dressed lady, a policeman, a doctor, a workman, etc.) and draw what the X-ray shows up!

4. Use the same method to represent a village, a town, a country. Use diagrams and maps to present your findings.

Exploitation

How could a village be built without metal? If, however, you were allowed to use just a little metal to live in this village, what would you use it for?

4. THE CONSUMPTION OF METALS

Level: II

Goals and objectives:

Provide accurate information on the role of metals in the economy and on the amounts consumed.

Reveal the sectors which consume the most.

Analyse critically the solutions recommended to avoid wasteful use of metals.

Draw pupils' attention to possible economies both in the making of objects and in the general organization of a particular service (transport, for example).

Duration: 3 to 4 sessions.

Disciplines: Economics, geography, physical sciences.

Equipment:

As for normal classwork.

Documents taken from newspapers.

Economic statistics.

Activities:

1. Using examples and figures taken from the documents, distinguish between:

metals used in large quantities for very common community purposes or individual needs;

rare metals used for highly specific purposes.

2. What are the specific characteristics of metals which make them essential or suitable for these purposes? Consider both the economic aspect (plentiful supply, ease of extraction, etc.) and their physical properties and the mining techniques involved.

3. Identify the economic sectors which are the biggest consumers of the main metals in the two categories distinguished above.

4. What could metal-saving strategies be based on:

   a big reduction in consumption by sectors not essential to human survival?

   durability and repairability of the objects?

   recycling?

   alternatives (other materials or other technical solutions for the same activity, such as transport or communications)?

   Organize a discussion with different points of view to examine these possibilities carefully.

5. Show that the amounts of energy consumed relate to the mining of ores and the refining, working and recycling of the metals. Try if possible to find figures on the subject.

Exploitation

(1) Organize a collection of old metals in your district; justify this action by explaining to the people you meet the need to economize and recycle metals, using what you regard as the most convincing arguments (if necessary, prepare a little notebook for this purpose).

(2) Consider in as practical a way as possible how a car should be constructed in order to economize on metals (and other materials); you could start with a rough analysis of the present components of a car and think about the problem for yourself; you could next, if possible, discuss your conclusions with car specialists. To go deeper into the question, repeat the process by taking account not only of cars but of your country's individual and public transport system in general.

EVALUATION

Questions

1. What are iron and steel obtained from?

2. Which economic sectors consume the most metal?

3. For what activities are you the most dependent on metals?

4. Are metals a renewable resource?

5. What can be done to economize and conserve metals?

6. Are the ore-producing countries the ones which utilize metals the most?

7. Do all metals have the same use and are they all used in big quantities? Give examples of different uses and different quantities consumed.

8. Why is it not possible to exploit metals existing in a diffuse form (e.g. copper in the oceans)?

9. Why are metals used for coins? Are monetary systems now based on other forms of currency?

10. For what properties is a rock considered as an ore that could be mined?

11. By what methods can metal be extracted from an ore?

12. Why did we have to wait until the nineteenth century before metals, especially iron and steel, were used extensively in everyday life?

Multiple choice

(1) If the wasteful use of metals is to be substantially reduced, we must ...

(a) manufacture objects with the longest possible life;

(b) develop our knowledge and technologies in regard to metal;

(c) organize the recycling of metals on a systematic basis;

(d) create a new geopolitical order;

(e) do all the four things mentioned above.

(2) The use of this is ... for preserving foods:

(a) always indispensable;

(b) never useful;

(c) never a forced requirement, but sometimes useful;

(d) always bad.

(3) At present cars are built to last on average ...

(a) two years; (b) ten years; (c) forty years.

(4) With present techniques cars could be made to last for:

(a) over two years;;

(b) over five years;

(c) over ten years;

(d) even longer.

(5) The manufacturer of armaments uses metals ...

(a) in very small quantities;

(b) rarely

(c) in very large quantities.

(6) Where metals are concerned, the exploitable reserves are limited ...

(a) only for a few metals;

(b) for none of them;

(c) for all metals;

(d) only for scarce metals.

Group evaluation based on activities

List the existing methods of economizing and recycling metals in your community. Propose another system and improvements to one of the methods already in use. Help to set up and operate this system.

CHAPTER IX

SOCIETIES AND RESOURCES

Until fairly recent times, sociologists probably paid more attention to regulatory mechanisms affecting resources (social structures, relations between individuals and groups, the organizational structure for management of the environment) than to their actual management. The same criticism could be levelled at economists, who often confine themselves to the graphic or strictly monetary presentation of exchanges.

The way in which a society procures its raw materials, processes them, chooses the type of goods to be offered to the consumer, plans their durability and envisages their recycling - in brief, the way it manages its resources of

raw materials;

energy;

and human labour,

represents the fundamental mechanism of that society.

For the resources already considered in other chapters (the soil, water, energy, metals), it would be easy to highlight important differences between societies in different parts of the world at a given period of time, or between the societies which succeed each other in the course of history in a particular place. As users of resources, societies can also be characterized by other features, such as:

the design of their dwellings and the use of building materials;

the production of waste matter, the resulting pollution and the recycling of this waste;

the concern to preserve a natural heritage (environments, species, genes) and also a cultural heritage (technological, aesthetic and artistic).

It would likewise be very interesting to consider the influence of accepted values on the management and conservation of resources.

The resources utilized in the habitat

Industrialization is accompanied by the concentration of people in cities, the establishment of communication networks (roads, railways, telephones, etc.) and an absolute requirement for energy distribution systems. Many different resources are drawn on to build cities and the habitat in general, for both individual and collective purposes. Here too, society has evolved from a lifestyle based on scattered dwellings or small groups of houses (villages), built from materials found locally or as near the site as possible, to a habitat which employs increasingly sophisticated products (reinforced concrete woodwork, metal goods, etc.), the raw materials for which are obtained from further and further away and need more and more transportation. The energy requirements for building, and for running costs (central heating, air-conditioning, etc.) are steadily rising, and certain types of construction are particularly wasteful of energy (tower blocks) or consume a

great deal (estates of detached houses). The consumption of energy for the heating and air-conditioning of homes depends to a great extent on how they are built and the insulation qualities of the materials used; a slight increase in the capital invested can give a handsome return on running costs over the years. For example, passive bioclimatic architecture and solar panels, which utilize a source of energy that costs nothing, make possible this type of long-term savings.

Waste matter: a new source of wealth

The growing quantity of waste matter and the diversity of its composition is indeed the final link in the chain of production which characterizes consumer societies. The pollution of air and water by industry, and of the soil and subsequently water by agriculture, are also revealing as to the way resources are used. In recent years, with the pressure of events arousing fears of shortages (oil crisis, growing scarcity of certain metals and so on), more serious attention is now being paid to the potential value of waste matter, which has come to be regarded as a new resource. Agricultural residues could produce methane (dung and liquid manure) and methanol (scrub and wood shavings), while the organic refuse of towns could be turned into compost of low-grade gas. The recovery of metals, glass, paper and plastics also produces significant savings of raw materials and energy. Rubbish tips often have a higher metal content than low-grade ores which are only just worth mining. In the developing countries, small craftsmen frequently show extraordinary ingenuity in finding new uses for objects which would be thrown away in industrialized countries (sandals and well buckets are made from tyres and inner tubes, frying pans from the lids of oildrums, oil-lamps from tin cans, etc.). To avoid wasting resources one of the first things to insist on is that products should be durable, repairable and re-cyclable.

The natural heritage

Nature has been considerably transformed by human activities but until recently these changes took place relatively slowly; a number of environments regarded as more difficult to manage were left alone (swamps, for instance); many 'marginal' lands or 'transitional zones' constituted biotopes hardly touched by man; and many forests treated according to the selection system kept the soil well covered and contained a diversity of trees comparable to the primeval forest. Modern machinery makes it possible rapidly to clear land of trees and scrub, and to drain and dry out areas of land which can in some cases be very extensive; and long-established practices of burning and overgrazing, which continue regardless of these developments, have now been joined by forms of deterioration arising from the proximity of huge urban centres and pollutants of all kinds.

The deterioration of nature has kept pace with progress: many environments have disappeared, together with the species they sheltered, and some species have been threatened with extinction by thoughtless development, hunting and fishing. All this is going on before our eyes. The trend is however being checked by an increasingly informed awareness of the relationship between man and nature, which implies the need to conserve and improve the quality and production potential of the environment so that it can continue to satisfy the material - and cultural - needs of present and future human populations.

Throughout the world, policies have been introduced in an effort to save certain environments (the humid zones for example) and to set aside areas of particular interest on account of their beauty and/or wealth of plant and

animal species (establishment of parks), but we do not want to end up with a few priceless pearls in a grey or devastated world. The natural environment must be protected even in the case of landscapes largely shaped by man in recent years (by re-introducing copses interspersed with pastureland, landscaping of quarries and gravel-pits, reforestation, etc.).

Ecology is now a science in its own right which makes an indispensable contribution to the proper management of nature and its resources.

The concept of the natural heritage has now been joined by the relatively new idea of the genetic heritage. For example, as a result of the creation by geneticists of modern strains of wheat and their introduction into certain semi-arid zones, the local varieties selected over many years by trial and error have disappeared, entailing the loss of the genetic potential or heritage of the local varieties concerned and depriving geneticists of a genetic instrument they would like to make use of. The only way of safeguarding the capital represented by the genetic heritage - not all of whose possibilities are yet known - is to preserve both wild and domesticated species, breeds and strains for both plants and animals.

ACTIVITY NOTES

1. HISTORY, CIVILIZATIONS AND RESOURCES MANAGEMENT

Level: II

Goals and objectives:

Identify the various stages of the history of technology in the pupil's own country.

Recognize the social impact of former or recent technical innovations.

Understand the relationship between technical development and the use of natural resources, the consumption of energy, pollution and so on.

Think about the choice now facing society between the accentuation of present trends and greater use of the so-called alternative technologies.

Duration: 1 to 2 weeks.

Disciplines: History, geography, economics, agronomy.

Equipment:

Books on the history of your country.

Books on the history of civilizations and techniques.

Activities:

1. Distinguish, in the history of your country since prehistoric times, periods characterized by clearly distinct lifestyles: e.g. in the case of Western Europe - pre-history, the middle ages, the eighteenth century, the beginnings of industrial society, the present time.

2. Divide the class into groups, with each group responsible for a period. Imagine within each group that you have been asked to prepare an 'Environmental Education Module' on the management and use of resources.

3. What happened in the period you are investigating with regard to:

   the use of natural resources, including as appropriate agriculture and forestry;

   the consumption of energy (what type? for what purposes?);

   the use of metals;

   the materials used for housing;

   the range of available techniques;

   the use of water and water pollution;

   the concern to avoid polluting the environment, etc.

4. Express the results of your documentary research in the form of comic strips.

5. Compare the various periods studied. Analyse the reasons for the changes.

6. What were the new technological factors which seem to you to have prompted or made possible certain changes?

7. Could you offer some reasoned value judgements regarding these changes?

Exploitation

Imagine a subsequent stage of the civilization, bearing in mind the resources it would require, hence the possibilities that appear truly feasible.

2. ATTITUDES TOWARDS THE CONSUMPTION AND MANAGEMENT OF RESOURCES

Level: I and II

Goals and objectives

Produce an awareness of advertising techniques and their encouragement of consumption.

Recognize forms of waste in everyday life.

Inculcate a thoughtful outlook.

Duration: 2 to 3 sessions, more if desired.

Disciplines: Economics, social sciences.

Equipment:

Popular magazines.

Materials to make games.

Activities:

1. In small groups, examine a page of advertisements from a magazine and note:

   (a) the values to which the advertisements refer (social success, popularity, power, etc.);

   (b) the extent to which the product advertised contributes (or fails to contribute) to the satisfaction of basic material or cultural needs;

   (c) whether purchases of the product have a large or small impact on the consumption and wasteful use of resources.

2. One could also list the words which represent what advertisements promise explicitly or implicitly (e.g. beauty, success, power, etc.). Note the articles or products which appear to correspond to each word. Think about and discuss this in order to find any other key words often used or avoided in advertising.

3. To develop an awareness of real needs and desires, try the following exercise:

   (a) each pupil spends five or ten minutes writing down what he would do if he were very rich;

   (b) each pupil spends five or ten minutes trying to recall three times in his life when he was truly happy and describes them briefly;

   (c) each pupil spends five minutes imagining himself as very poor: how would he then survive, and what would he really want?

4. Does advertising really inform people? Does it often encourage waste?

5. Make a game based on two different types of squares:

   (a) the first type obliges you to go back because these squares represent a selfish attitude or a lack of concern to save resources. For example:

   - you drive to work alone in your car;

   - you change your wardrobe every year, throwing away your out-of-fashion clothes;

   - you water your front garden even when there is a shortage of water in summer;

   - you leave all the lights on throughout the house;

   - you buy lots of gadgets which you don't use;

   - you forget to take a shopping basket with you when you go shopping and always ask for bags which you will throw away afterwards;

   - after a picnic you leave behind your rubbish such as aluminium foil, bottles, tin cans, etc.;

- you throw into the rubbish bin kitchen scraps, fruit parings, etc., which could be turned into excellent compost or humus (if you live in the country);

- you throw bottles away instead of saving them for collection and recycling;

- you throw away your newspapers and cardboard instead of having them recycled;

- you buy disposable lighters, razors, ball-point pens and so on;

(make the squares big enough to contain a drawing and a few words of text)

(b) the second type, on the contrary, allows you to advance because you are concerned for the good of the community. For example:

- you organize a collection of bottles and paper in your area;

- you stop smoking;

- you insulate your house in order to save on energy for heating;

- you use recycled paper;

- you use ordinary household soap instead of detergents which pollute;

- you go to school by public transport, by bicycle, on foot or roller skates instead of being driven there by car;

- you give preference to buying clothes made of natural fibres (cotton, wool, etc.):

(c) Put numbers (from 1 to 3) in each of the 'bad' squares to reflect the impact on the environment: for example, buying disposable products is relatively detrimental to the conservation of resources so you put the number '2';

(d) Colour the 'good' squares green and the 'bad' ones white, then shuffle them and set out in a random sequence with the first square marked 'start' and the last one 'end';

(e) cast a die and advance as many squares as the number shown; if you land on a good square, you can stay there until it is your turn again, but if you land on a bad one you have to go back as many squares as the number indicates. The first person to reach the 'end' square wins.

Exploitation

(1) Discuss the following question: in order to improve the management of resources, does the example set by each person really encourage others to do likewise or would it be better to try to change things solely through the country's economic policy?

(2) What role could consumer associations play in efforts to improve the management of natural resources.

3. THE HABITAT

Level: I and II

Goals and objectives

Draw attention to the materials used for the habitat.

Bring out the importance of the structure of the habitat for all types of consumption.

Develop the feeling of belonging to a community which must manage its resources.

Duration 2 weeks.

Disciplines: Various, including drawing, in co-operation with professional architects and town planners, etc., from outside the school.

Activities:

1. Divide the class into several groups and let each group select a public building or house with a known date of construction; try to arrange that the groups choose buildings whose dates span as long a period of time as possible.

2. Find out by observation and investigation the nature of the materials used for each building and exactly where the raw materials for them came from. What types of transport and processing were required for these materials? What type of energy was used at the processing stage and during the actual construction?

3. Do you know how much energy is required to make a tonne of cement? Or a tonne of aluminium? Is energy needed to obtain stone or wood?

4. Show by means of simple drawings the structure of the buildings studied, using different colours for the different materials used.

5. Explain clearly the historical differences noted regarding the nature of the materials used, the ways they are employed, the distances they have had to be brought, etc.

6. Make a similar comparison for other regions of your country or for various countries in the world.

7. Now take a more general view of populated centres (villages, towns, districts). What do we find in addition to the houses themselves?

   Draw diagrams to show the different networks for:

   - various types of traffic (cars, pedestrians, etc.);

   - communications (telephone, etc.);

- the distribution of energy (gas, electricity, etc.);

- the distribution of drinking water;

- the sewage system.

What resources were needed to build them and what outlay is entailed by their use, operation and maintenance?

8. What places or premises are used by people in common? Are all these places used by the same groups of individuals? How does their location affect the way in which communication networks and facilities are used, hence the amount of energy spent on getting around?

9. Who manages the resources used (water, energy, etc.) for the community facilities or the public places in your town? Could savings be made? In the case of your school, for example, what could you as an individual do to reduce the amount of energy consumed there and to avoid wasting materials.

Exploitation

(1) Take an active part in (or at least keep yourself closely informed about) the preparation of any plan concerning your district or village (e.g. land-use plan, scheme for urban development); try to understand how such plans are worked out, the constraints involved, how decisions are arrived at, and so on. Evaluate the proposals or decisions by assessing to what extent they facilitate the management of various types of resource (including land) and meet the needs of the community.

(2) Imagine that you possess building land for 50 plots of 1,000 m^2 each, to provide 50 homes with a floor area of 100 m^2 each. Try to think of several alternative solutions for the use of the land; for example, 50 separate houses, three small blocks of flats or a single tower block. What would you do with the space not built upon? How could you save materials and energy when actually building? How could you keep running costs (especially for energy) as low as possible? Would it be possible to provide some shared facilities?

4. WASTE MATTER: AN UNEXPECTED RESOURCE

Level: I and II

Goals and objectives

Estimate the amount and types of household waste disposed of every week.

Understand recovery processes and their relative advantages.

Understand methods of treating sewage.

Obtain background information on which to base attitudes opposed to waste.

Duration: 2 to 3 sessions; prior collection of household waste over one week.

Disciplines: Mathematics, physics, biology, agronomy, economics.

Equipment:

As for normal classwork.

Plastic bags.

Material for making spring balances (springs, old medicine, tubes, etc.).

Activities:

1. Take a look at the contents of your refuse bin. For one week, put your refuse into six separate bags:

   (a) metals;

   (b) glass;

   (c) paper and cardboard;

   (d) organic waste (peelings, etc.) (weigh daily but do not keep);

   (e) plastics

   (f) other refuse.

2. Weigh the bags roughly (you could make spring balances with tubes and springs and check their accuracy) and work out the percentage of each category.

3. Compare your results; work out an average for the class and compare this with the published figures for a town.

4. Make one or more comic strips to show how each of the waste products might be recovered (e.g. composting for organic waste, recycling for paper, metal and glass, the production of energy).

5. Discuss the advantages and disadvantages of the various methods; examine selection criteria.

6. Investigate how household refuse is dealt with (rubbish tips, burning, partial re-use or recycling).

7. How are the effluents from sewage treated in your town?

8. Look beyond household waste at the broader problem of making the best possible use of:

   certain industrial waste products;

   agricultural and forestry residues.

Exploitation

Is there a collection system for paper, glass or metal in your district? If not, make a plan for one. Contact the various firms and industries likely to be interested and suggest your plan to the authorities concerned (town council or local committee). Do as much as you can to get it implemented.

5. NATURE: A RESOURCE TO BE PROTECTED

Level: I and II

Goals and objectives

The pupil should:

be familiar with the vegetation and forest cover of his region and country;

know how to produce a nature guide;

be able to identify the impact of human activities on nature;

know about the conservation activities in his country and the reasons for them;

understand what is meant by the terms 'natural heritage' and 'genetic heritage' and why they should be preserved.

Duration: a few sessions, outings and activities spread over a year.

Disciplines: Botany, zoology, ecology, drawing, geography.

Equipment:

For drawing.

For collecting samples of plant and animal life.

Manuals for the identification of plants and animals, and nature guides.

Newspapers and illustrated magazines for cutting out photographs.

Activities:

1. If possible arrange for a short stay in the country, or a number of walks in the outskirts of your town, with the purpose of making an inventory of the trees, flowers, mammals, birds and insects, etc.

2. Draw up a plan for a nature guide recommending a particular walk around your town; describe and draw flowers, trees and birds to be found there at different times of year. Press flowers and leaves to preserve them as dried plants. Draw trees in silhouette.

3. Draw some views of the countryside to bring out the role played by plants. Use pictures cut out from newspapers, etc., to make display panel showing the variety of landscapes, etc., in the world.

4. By observing the landscape around you, state what human activities spoil or destroy nature. In what way is nature protected or destroyed in your country?

5. What wild animals are to be found in your country? Are they carefully protected or gradually becoming extinct? What flowers, birds, etc., are in danger of extinction? What are the organizations that protect them? Do you know of any animals in the world seriously threatened with extinction?

6. In your opinion, why must nature be protected and the various species of animals and plants safeguarded?

Exploitation (to be explored more thoroughly at level II):

(1) What is the natural heritage? The genetic heritage? Find information on the genetic potential of wheat, maize, apples, etc., that will help you answer these questions.

(2) Make a list of the reasons that can be given for protecting or for destroying nature. Discuss them as thoroughly as possible. If necessary, organize a role-playing game with an agronomist, an ecologist, a hunter, an industrialist, a forester, a cleric, etc.

EVALUATION

Questions

1. What are the most important scientific discoveries and the most important technologies for your life?

2. What are the reasons for the disappearance of animal or plant species?

3. What are the links between advertising and consumption?

4. Why does advertising urge people to buy disposable objects? Where do disposable products end up?

5. What is the role of modern means of communication and transport (telephone, television, motorways, etc.) in an industrialized country? What is their impact on the use of resources?

6. Show how the nature of the materials used for the habitat in all regions of the world has always depended on what is available locally.

7. Could you indicate some types of architecture which make it possible to save energy?

8. What are the factors which have governed the development of the habitat in your country?

9. What items of household refuse could be recovered and/or recycled?

10. What agricultural residues could be processed so as to produce energy?

Multiple choice

(1) Agricultural techniques such as the preparation of the soil, irrigation and fertilizing ...:

(a) are the same everywhere;

(b) are not very important;

(c) vary from country to country and change over time;

(d) have not changed very much.

(2) In the industrialized countries, a modern communication medium such as the telephone ...:

(a) is a gadget of no importance;

(b) has transformed human relationships;

(c) has no real impact on society;

(d) does not help to save energy;

(e) is not really useful.

(3) To safeguard animal and plant life, it is necessary to ...:

(a) plant flowers on one's balcony;

(b) become a vegetarian;

(c) keep a pet;

(d) preserve the environments in which animals and plants live;

(e) have not only a large number of aquariums but also large aviaries.

(4) The family, friends, the school and television ... the lifestyles we choose:

(a) having nothing to do with;

(b) rarely influence;

(c) have no real impact on;

(d) have a decisive impact on.

(5) Anywhere in the world, building a house always requires:

(a) wood;

(b) glass;

(c) stone;

(d) cement;

(e) land;

(f) fibres;

(g) metal;

(h) space;

(i) electricity networks;

(j) an assured telephone connection;

(k) several of these materials or facilities;

(l) all of them.

(6) The forms of housing which are the most costly in upkeep and energy are ...:

(a) tower blocks;

(b) igloos;

(c) tents;

(d) detached houses;

(e) small blocks of flats.

(7) Agricultural residues can often be used as ...:

(a) a source of energy;

(b) fertilizer;

(c) extra organic matter to maintain the soil structure;

(d) animal feed;

(e) all of the above;

(f) none of the above.

Group evaluation based on activities

Imagine an ideal situation in which you are in charge of the planning and running of a small town of 5,000 inhabitants situated deep in the country, with rivers and forests and crops and pasture-land all around it. Make a detailed plan explaining how you intend to go about your task, what you would construct and how you would manage it. In addition to general problems, and assuming that you are able to control the aspects listed below, examine the consequences of some alternative possibilities:

(1) advertising: you could decide either not to have any or to use it for other purposes than to encourage consumption (say what purposes);

(2) education: find the form of education that you would like (activities, curricula) and state your goals;

(3) community facilities: define their nature and role;

(4) food: seek direct relations with the farms in the area and use unprocessed products, without preservatives or complicated packaging. Organize transport and shops along the same lines;

(5) town-country relations: see if they could be founded on something other than a purely commercial basis;

(6) water: safeguard its purity and economize it as much as possible;

(7) transport: find a system which saves on energy and resources;

(8) household consumption of energy: try to cut it down as much as possible by a wise choice of energy sources and techniques to match the various uses.

EPILOGUE

The environment is under attack from many quarters, sometimes by natural phenomena and sometimes by man himself; however, not all the attacks do irreparable harm and many of them could be avoided. One of the aims of environmental education is to contribute actively to stimulating that awareness which is necessary to prompt further concrete measures and a personal involvement in the already broad range of efforts being made in this field.

Co-ordination LAB/86